FEBRUARY, 1954

HEATING AND VENTILATING

...UDING AIR CONDITIONING – PIPING – REFRIGERATION – AIR SANITATION

Solar Energy Received in the United States
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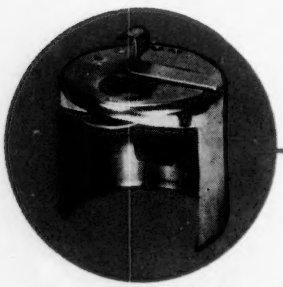
Here's a *Real* STEAM TRAP PACKAGE



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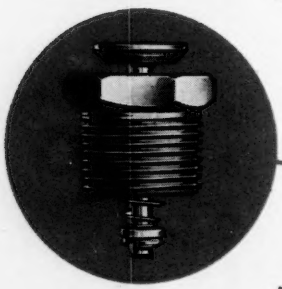

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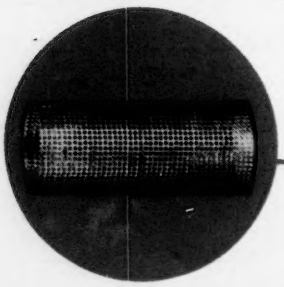

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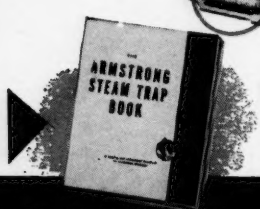

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ARMSTRONG STEAM TRAPS

Unique heat exhaust problem solved

POWER-FLOW ROOF VENTILATOR

exhausts hot air from plastic dome of new Ford Rotunda

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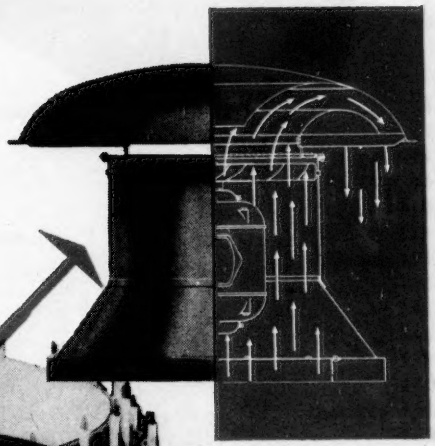

Low, streamlined silhouette of Power-Flow Roof Ventilator harmonizes with Ford Rotunda's geodesic dome (Architect, R. Buckminster Fuller). DeBothezat manufactured this unit specially in aluminum to match the framework of the geodesic dome and to save weight.

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HEATING AND VENTILATING

A MONTHLY MAGAZINE FOR ENGINEERS AND CONTRACTORS CONCERNED WITH THE DESIGN AND APPLICATION OF AIR CONDITIONING, REFRIGERATION, PIPING, PLUMBING, AIR SANITATION, HEATING AND VENTILATION IN BUILDINGS

February, 1954
VOLUME 51—NO. 2

The Cover: Winter scene at Sun Valley, Idaho. Photograph by Toni Frissell, courtesy of Union Pacific Railroad. See page 97 for charts on solar radiation.

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Washington News

LORING F. OVERMAN

RECENT happenings in Washington offer encouraging evidence that the strong hand which directed the Normandy crossings in World War II is indeed at the helm of the ship of state.

The same type of detailed planning, and the same degree of confidence in the ultimate result have been apparent in each of the President's messages to the reconvened Congress. In a year when all of the House members and one third of those in the Senate are up for reelection, there is some grumbling over the heavy work load assigned by the President. Many members of Congress had hoped to handle only a minimum amount of must legislation quickly, and then hurry home to start campaigning. But the Administration apparently takes the view that the political futures of those seeking reelection will depend upon doing a good job on Capitol Hill.

Many Washington observers concede that all requests made by the President cannot be acted upon during the present session. Those requests involve a tax overhaul, cuts in defense expenditures, Taft-Hartley revisions, social security changes, housing, health legislation, and tariffs. Many of these subjects are extremely controversial; any one of them could tie up Congress from now until adjournment time.

There is a suspicion on Capitol Hill that the President is piling the requests up with a heavy hand in the hope that the lawmakers will fight their way through far more work than they now believe possible. It is not considered likely that Taft-Hartley revisions can be agreed upon before mid-summer adjournment. Farm legislation, too, is expected to result in a compromise extension of present support plans. The program calls for adoption of the sliding scale of farm supports actually provided for in the present law, but suspended again and again during the Korean hassle.

Of the several things which affect the heating, ventilating and air-conditioning industries more or less directly, are the Administrations' plans for defense cuts, for housing, for tax revisions, and for liberalized foreign trade policies.

Construction Props

At press time for this column, the President had not submitted his housing message to Congress. It seemed likely, however, that in making plans to continue the present pace of 1,000,000 housing unit starts yearly, much attention would be paid to slum clearance and the rehabilitation of blighted areas in cities. While this type of housing will not call for air-conditioning, it should provide an important market for central heating installations. Also there will be secondary dividends of such programs—the construction of new and modern quarters for commercial, recreational and industrial tenants displaced in the slum clearance program. Such programs will also spark the construction of new facilities within the rehabilitated areas.

Confident that Congress will act quickly and favorably on the President's housing recommendations, the Housing and Home Finance Agency is proceeding with related projects for the guidance of building planners.

Housing Market Analysis

What H&V folks may look for in the housing field is to be outlined in a study, "Housing Market Analysis", to be issued soon by HHFA. The report will be available at 50 cents from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. Prepared for HHFA by Columbia University's Institute for Land Use and Housing Studies, the 91-page publication aims to clarify some of the basic concepts involved in housing market analysis, and to help stimulate greater precision in developing techniques for preparing local market studies.

Topics investigated in the study include the nature of housing markets; the forces governing markets for various types of houses; the relationship between the market for existing dwellings and the conditions for new construction; and the effect of economic growth and occupational status on migration of population and volume of housing. Also included are a series of appendices explaining, among other things, how to translate changes in the gross national product into changes in locality incomes.

Code Enforcement Guide

Another HHFA publication, "Local Development and Enforcement of Housing Codes" is soon to be available for 40 cents from the Superintendent of Documents. Using examples of actual housing codes and enforcement systems now in operation, the 55-page report explains the contents and administration of such codes. It points out two major aspects of the problem of creating and administering minimum housing standards: (1) general considerations involved in developing a minimum housing code for a particular community, and (2) dependence of a municipal policy on housing standards on the coordination of certain functions in the health, building, fire, and welfare departments and housing authorities.

Both aspects are discussed as they have been involved in an actual program which has become known as the Baltimore plan. Appendices also contain the housing codes of Milwaukee, Wis., and St. Louis, Mo.

"Many cities are now recognizing that the quality of housing is a factor which has an enormous influence upon the individual and the community," the booklet states. "Cities are realizing that the quality of housing involves more than safety from fire and structural failure. It involves, at a minimum, the state of repair of the dwelling, the kind and state of repair of equipment and facilities, the space provided per occupant, adequate light and air, and the neighborhood environment.

"Consequently, many cities are seeking ways to insure that their housing will meet minimum standards for some or all of these criteria. At present, housing quality is not covered by the purposes, technical requirements,

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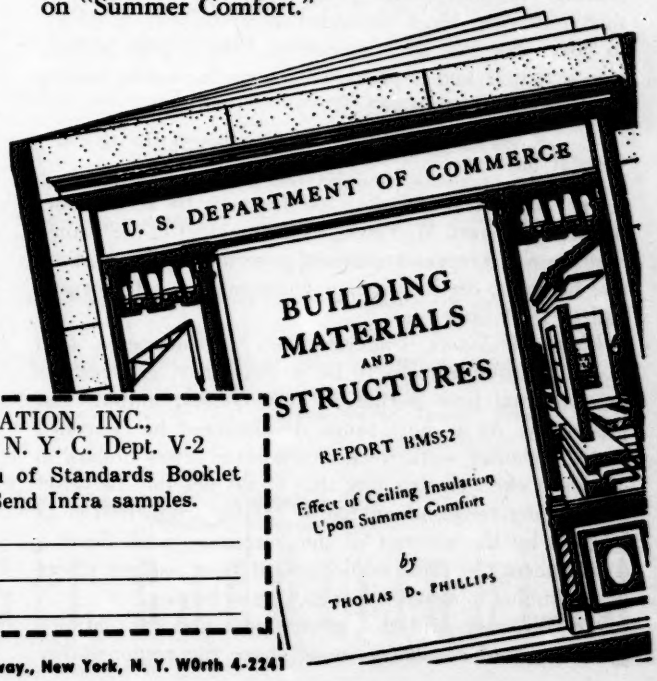

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or administration of most building or other construction codes, or by zoning ordinances."

Modular Construction

A guide for architectural and engineering draftsmen in applying the principles of modular coordination to working drawings is provided in a new 29-page booklet just published by the HHFA. Entitled "Basic Principles of Modular Coordination", the booklet is available for 25 cents from the Superintendent of Documents.

Other HHFA publications dealing with modular coordination, also available from the U. S. Government Printing Office, are "Modular Coordination", 15 cents, and "The Modular Method in Dwelling Design," 30 cents.

The "basic principles" booklet consists primarily of drawings illustrating practical applications of the 4-inch module. Illustrations show coordinated assemblies of modular brick, brick with clay tile backup, joining of dissimilar materials, modular framing, and various building products sized in multiples of 4 inches. The advantages of modular coordination, the publication states, are: (1) standardization of building materials on a national rather than a regional or local basis; (2) simplification of architectural design and construction; (3) reduction of cutting and fitting time and waste of materials; (4) increased productivity of labor.

About College Housing

Administrator Albert M. Cole of the Housing and Home Finance Agency announced on January 15 that the interest rate on college housing loans for the period from January 1 to July 1, 1954, will remain at 3.5%, the same rate as prevailed during the past six month period.

The Housing Amendments of 1953 empower the HHFA Administrator to set the rate for college housing loans at not less than the average yield on outstanding government obligations with a maturity of 15 years or longer. During November, that figure amounted to 2⅞%. To that minimum, Mr. Cole added an additional ⅝ of 1% to cover the cost of administering the college housing loan program, and to provide a reserve for losses, making the total interest rate 3½%.

Crystal Ball

Speaking in Washington on January 16 at a dinner honoring Richard M. Nixon, Vice President of the United States, several representatives of government, the military, and business, drew optimistic comments from the crystal ball of 1954 forecasts.

Walter Williams, Undersecretary of Commerce, said that the nation appears to be moving from an overtime to a normal time period of employment, output, and prosperity. As a short range development he conceded that the shorter work week means some fewer dollars in labor's pocket. He felt that this might possibly be offset by the long range advantage of having production costs lowered by the amount of the overtime saved. Such a development, he said, would permit lower selling prices as a stimulus to sustained or increased buying.

Mr. Williams said that government and the nation's producers and consumers must share the responsibility for prosperity during the months ahead. On government's side, Mr. Williams noted:

(1) Government expenses are being trimmed.

(2) Government spending is still very high—a sustaining factor in keeping the economy at present levels.

(3) Government is taking steps to foster a favorable business climate.

(4) Government stands ready, at a moment's notice, to apply tremendous remedial power in the event of any slackening of the business pace.

His suggestions to business and to consumer:

(1) Consumers should buy normally.

(2) Business should use effective sales promotion to encourage normal buying habits.

(3) Business should keep its house in order, through normal expansion of plant and replacement of equipment.

(4) Labor and management should join hands in assuring maximum productivity.

William P. Rogers, Deputy Attorney General, was asked whether his department considered as constitutional the President's suggestion that native born Americans who embrace the communist cause should be deprived of citizenship. He replied that he felt that any person who renounced his allegiance to the United States by joining an organization pledged to its overthrow had already forfeited his rights to citizenship.

Roy T. Hurley, Curtis-Wright Corporation, was asked whether our planes are on a par with, or ahead or behind other countries. He replied that this nation enjoys world leadership in both commercial and military aviation. He predicted that commercial planes will continue to operate most efficiently in the foreseeable future at below-sonic speeds, while military planes will be of the jet type operating beyond the sonic level. Future prosperity of the industry, he said, will depend upon provision made for the rapid obsolescence of planes and the tools which fashion them, and freedom from government subsidies.

Harold E. Talbot, Secretary of the Air Force, reported that current cut-backs in military personnel will not result in a shortage of trained A-bomber pilots.

Washington Miscellany

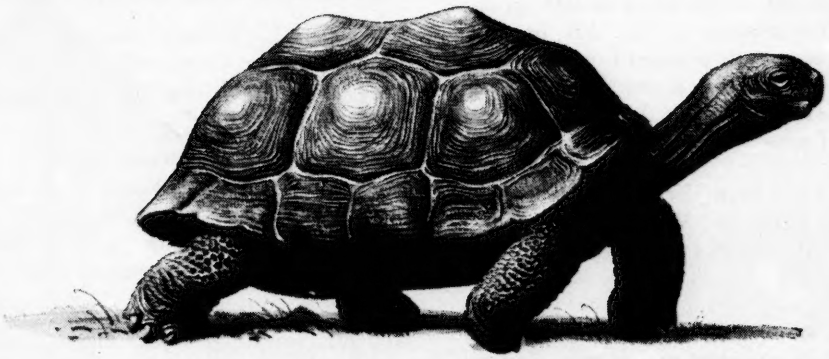
Streamlining Urged. A committee named last August to study the organizational structure of the Army and recommend improvements, has submitted a 69-page study recommending measures for the improvement of supply management in the Army, and for the creation of a Vice Chief of Staff for Supply. Similar studies are under way in both the Navy and Air Force. The report is based on the thesis that policy-making control should be vested in civilians, while the Chief of Staff should be the operations manager of the Army.

DMS Regulations Previewed. Final drafts of revised Defense Materials System regulations have been tentatively approved by representatives of steel, aircraft and automotive industries. The regulations were scheduled for early release, to become effective during the second quarter of this year. Although military requirements continue to drop, it was considered necessary to retain the DMS regulations:

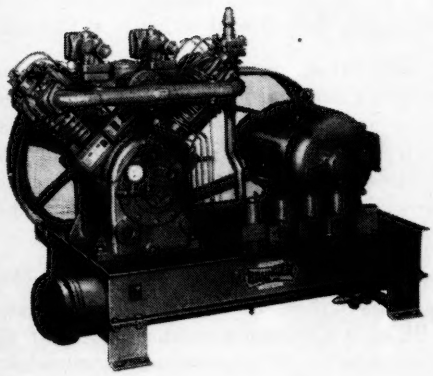
(1) To assure sufficient production to meet military requirements;

(2) To spread the load of military orders.

in air conditioning, too...



SLOW SPEED *means* LONG LIFE



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SELF-CONTAINED AIR CONDITIONERS

—completely packaged, easy to install and operate, are supplied in various models in sizes 2 H.P. to 20 H.P. — for residential and commercial use.

Why does the turtle live so long?

From an engineering viewpoint, the answer would probably be "Slow Speed!" Because the speed with which things *move* has a vital effect upon their life and usefulness, the design engineer is *always* concerned with doing *more* work with *less* motion.

Famous BRUNNER slow-speed COMPRESSORS are good examples of this principle. Because they operate at speeds much slower than other compressors of the same capacities, Brunner Compressors deliver full capacity air conditioning with *less* costly motion—*less* wear on working parts, *less* maintenance required — and *lower* operating costs, too.

That's *one* good reason so many architects and consultants specify Brunner equipment on every air conditioning job — for utmost dependability, economy and long-range customer satisfaction. There are *other* reasons, too — so why not get the complete Brunner story? See your Brunner representative — or write us.

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air conditioning

BRIEFLY STATED

• Appointment of Kenneth C. Davidson as sales promotion manager for Drayer-Hanson, Inc., has been announced. Mr. Davidson, recently released from active duty with the U. S. Army, will head up a new sales promotion department at Drayer-Hanson under A. L. Hanson, vice president in charge of sales and engineering.

• Wallace R. Persons has been elected president and a director of the Emerson Electric Manufacturing Co., of St. Louis. Mr. Persons has been vice-president and general sales manager of the Lincoln Electric Company of Cleveland, O., for the last seven years. As Emerson's president, the 44-year-old Mr. Persons will succeed W. S. Snead, who is now both president and chairman of the board of directors. Mr. Snead has been an Emerson director since 1937 and has taken an active part in the company's management since 1942. He will remain as board chairman.

• Charles B. Sweatt has been elected to the newly created post of vice chairman of the board of Minneapolis-Honeywell Regulator Co. and two other officers have been elected executive vice presidents. The new executive vice presidents are Tom McDonald and A. M. Wilson. Both formerly had the title of vice president. Charles B. Sweatt, younger brother of board chairman Harold W. Sweatt, has been an executive of Honeywell since the inception of the presently-formed corporation, serving first as vice president and, since 1945, as executive vice president.

• William H. Baker, Jr., has been appointed vice president of the Sunbeam Air Conditioner Division of American Radiator & Standard Sanitary Corp.

• Davis Engineering Corporation of Elizabeth, New Jersey announces the election of A. O. Jaeckel to the office of president. Mr. Jaeckel, who has been associated with the corporation since 1926, will continue also as general manager. Frank F. Kunca, formerly comptroller of the corporation, was elected treasurer.

• Jackson and Church Co. manufacturer of large warm air furnaces has named Alfred C. Drouillard manager of furnace development. Previous to joining J-C, Mr. Drouillard was project engineer with Bryant Heater Division of Affiliated Gas Equipment, Inc., Cleveland.

• Program plans for the 1954 annual short course in corrosion held by the National Association of Corrosion Engineers are under way. The five-day course is to be held on the campus of Washington State College at Pullman, February 1-5, 1954.

• The A. O. Smith Corp. of Milwaukee has purchased Glascote Products, Inc. of Cleveland, Ohio, a manufacturer of glass coated equipment for the chemical and chemical processing industries. Glascote, founded as The Glascoating Co., will be operated as a subsidiary of A. O. Smith and will retain its present name. L. T. Hickey, a member of the A. O. Smith management staff, has been named vice president and general manager of Glascote.

• William Few has been appointed chief engineer at Penn Controls, Inc., of Goshen, Ind. He comes to Penn from the Clark Controller Co. of Cleveland where he was manager of the electronic division.

• Charles U. Williams, founder of the Williams Oil-O-Matic Heating Corp. and a pioneer in the oil heating industry, died October 30 at his home in Bloomington, Ill. He was 86.

• In 1954, Chrysler Corp.'s Airtemp Division will produce four air-cooled residential air conditioners for each water-cooled unit. Since Airtemp's air-cooled models were introduced last May, sales of air-cooled units alone have exceeded sales of water-cooled models by 54%.

• Erie Forge & Steel Corp., which has been experimenting for more than a year under a license agreement in the development of reinforced plastic pipe for use in the oil and gas industries, has assigned the agreement to a newly formed company. The new company is the Erie Reinforced Plastic Pipe Corp. It will be headed by E. Richard Ebe.

• George P. Hough of Chicago has been appointed general manager of the Permaglas-Heating Division of A. O. Smith Corp. at Kankakee, Ill. He continues his duties as assistant to the president of A. O. Smith in the North Central region, the office of which is at Chicago.

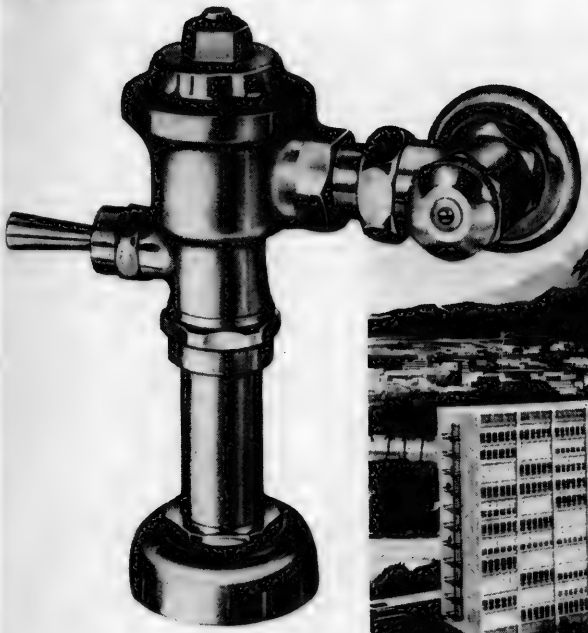
• The National Automobile Dealers Association and the Automobile Manufacturers Association have been invited to select a committee to meet with a like committee from the Refrigeration and Air Conditioning Contractors Association toward establishing stations for servicing and installation of automobile air conditioning in the field by qualified mechanics.

• Formation of an eastern manufacturers group within the Gas Appliance Manufacturers Association's water heater division has been announced by the trade group. Eleven manufacturers' representatives attended the first meeting of the group recently held in Cleveland. Harry B. Carbon of Bastian-Morley Co., Inc., was elected chairman and Lee W. Rasch of the Rasch Manufacturing Corp. was named vice chairman. The group was formed of GAMA water heater manufacturers who are not members of the Pacific Coast Gas Association which has long had its own water heater organization. It will discuss primarily problems of interest to eastern manufacturers and will act in the East as does its counterpart in the West.

• More than 2,000 refrigeration service engineers, contractors, wholesalers and manufacturers from all parts of the country are expected to attend the ARI Educational Conference on commercial refrigeration and air conditioning to be held on March 11-12-13, 1954, at the Municipal Auditorium in Long Beach, California.

• The Third Annual Industrial Ventilation Conference will be held at the Kellogg Center, Michigan State College, East Lansing, Michigan, on February 22-25, 1954. This course is sponsored jointly by the School of Engineering, Michigan State College, and the Division of Occupational Health, Michigan Department of Health, with the cooperation of industry. As in the past, this course will take the form of general assembly meetings, demonstrations, and small group class sessions.

And in Peru — A FUTURE OF FAULTLESS SERVICE



HOSPITAL CENTRAL DE LIMA
lima, peru
EDWARD D. STONE and
A. L. AYDELOTT
associated architects
PETER W. BRUDER
mechanical engineer
AMERICAN RADIATOR &
STANDARD SANITARY CORP.
exporting manufacturer of plumbing fixtures

This international showpiece and proud COYNE & DELANY project—among the largest hospitals ever to be built in the Western Hemisphere—skillfully knits a 500 bed general hospital to a 350 bed maternity section. Now under construction by the Republic of Peru from U. S. designs, it is huge by any standard. Nevertheless, careful study has preserved a pleasant patio-dotted plan coupled with complete integration.

As for the mechanical equipment, thoughtful planning has further expressed itself in the specification of over 1200 DELANY diaphragm type FLUSH VALVES. In our 75th year, both at home and abroad, DELANY remains—"the fastest growing name in flush valves."

This new "HAND BOOK and CATALOG No. 53" is the most comprehensive of its kind—designed for everyday reference . . . 19 pages of installation details for exposed, concealed and special FLUSH VALVE installations . . . over 75 blue prints . . . cut away views . . . many pages of charts, formulae, piping details . . . sent free, if requested on firm letterhead.

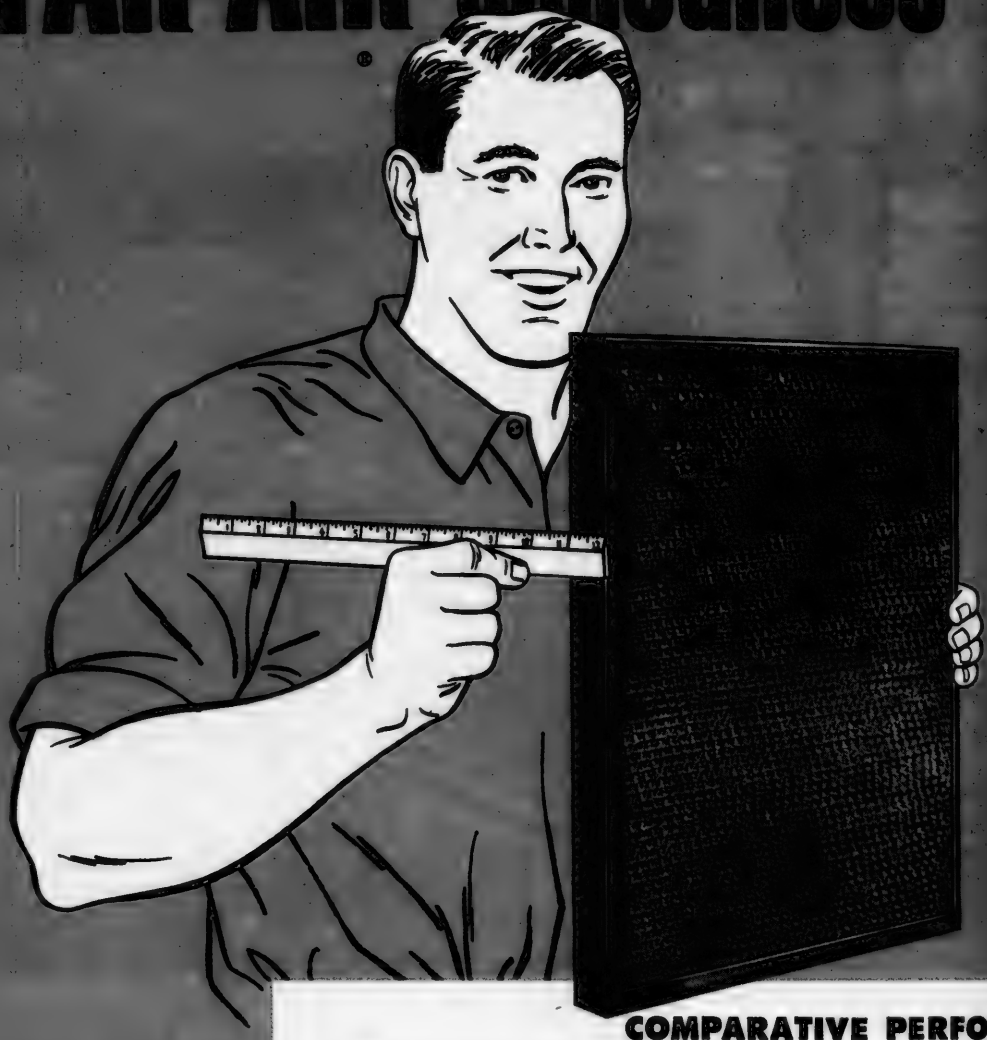
COYNE & DELANY CO. • 834 KENT AVE. • BROOKLYN, NEW YORK

IN CANADA: THE JAMES ROBERTSON CO., LTD.

DELANY *Flush* VALVES

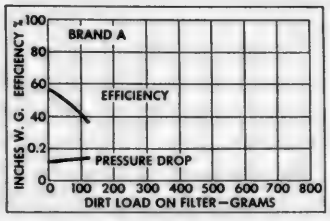
Since 1879

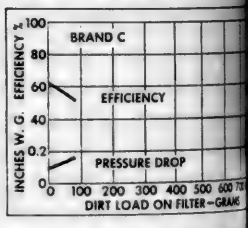
FAR-AIR announces



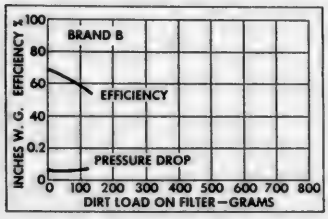
Better by FARR
Better buy FARR

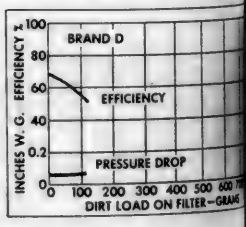
COMPARATIVE PERFORMAN





ORDINARY 1" FILTER AT 800 CFM





ALL CURVES BASED ON 20x20x1" FILTERS

h-low velocity 1" filter

HOLDS 7 TIMES AS MUCH DIRT AS OTHER 1" FILTERS

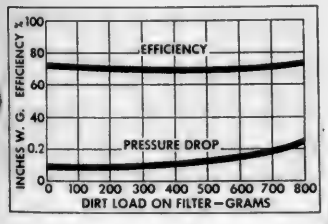
rs half-again as much clean air because of 50% greater capacity
Gives sustained efficient performance with low pressure loss
Can be used at either high or low velocity

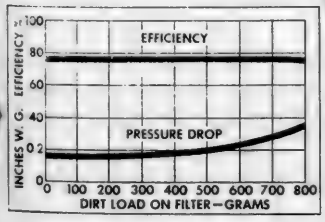
at last is a scientifically designed, ruggedly built, all metal, high velocity . It is no longer necessary to make ex- never-ending replacements . . . or put poor performance as ordinary 1" fil- roach the useless point.

d on the famous Far-Air herringbone his new gabled-crimp 1" filter is actu- ficient as most 2" types. Quantitative e it's the best 1" filter on the mar- holds up to 800 grams of Standardized Cleaner Test Dust before cleaning is . Compare the curves—see for your- holds 7 times as much dirt as other Far-Air 1" filters load progressively— 2"—and give you high efficiency air n without critical pressure loss right up to cleaning time. Cleaning is simple and easy. With reasonable care your Far-Air filters will last indefinitely.

This new-type filter opens up new and exciting possibilities in many fields. Design engineers can now get higher quality performance in 1" frames. Equipment manufacturers can attain greater efficiency and economy in their products with ⅓ less space for filter units. Service organizations need make fewer calls to maintain safe, dependable air filtration for their customers.

Eliminate the wasteful expense of inefficient filters—save time and trouble—get better air filtration at lower cost. Write today for complete information. Farr Company, P. O. Box 10187, Airport Station, Los Angeles 45.





ORIGINATORS OF FAR-AIR CERTIFIED FILTER SERVICE

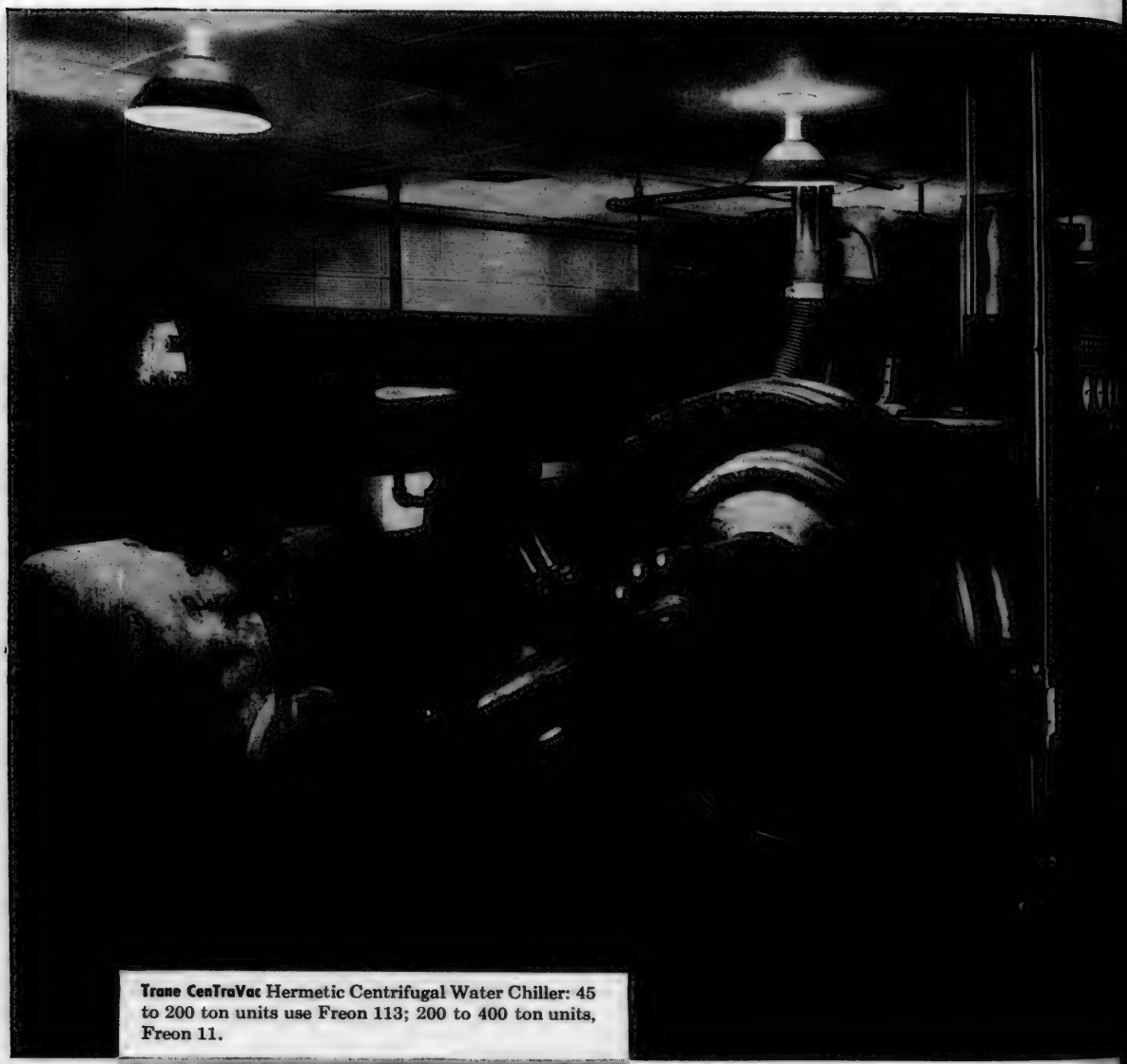
FARR COMPANY

NO COMPROMISE ON QUALITY

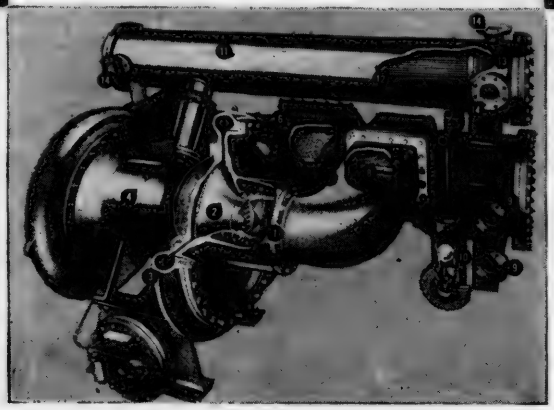
Los Angeles, New York, Chicago, Memphis

MANUFACTURED UNDER LICENSE BY FARR COMPANY MANUFACTURING LTD., MONTREAL, CANADA

Trane CenTraVac centrifugal wate
stable operation down t



Trane CenTraVac Hermetic Centrifugal Water Chiller: 45 to 200 ton units use Freon 113; 200 to 400 ton units, Freon 11.



1) Vane control—permits operation down to 10% of
capacity. 2) Impeller—assures high efficiency. 3)
housing—smooth gas flow. 4) Motor—hermetically
eliminates shaft seals and gear boxes, gives quieter
5) Lubrication system—fully protected from failure.
orator—semi-flooded type. 7) Tube bundle. 8) Elimi
prevents liquid carry-over. 9) Evaporator water
—2, 3 or 4 pass, give flexibility for all water flow
10) Float valve—refrigerant flow control. 11)
12) Tube bundle. 13) Water boxes—marine type.
connections.

chiller—assures 10% of capacity!

Now, with the CenTraVac, you can design a system that automatically adjusts to varying cooling requirements with power savings in almost direct proportion to load variations.

In any air conditioning system the design load exists only part of the time. The CenTraVac meets smaller load requirements by automatically throttling down smoothly—and in infinitely small increments — to as low as 10% of rated capacity. It allows, for the first time, partial operation without a large penalty in operating costs! For example:

At 80% load, power consumption is 77%; at 50%, it requires 50% power; at 10% load it requires only 22% power.

It is the only unit that permits *stable* operation over such a wide range (100% down to 10% of capacity).

Yet, wide capacity control is only part of the CenTraVac story. Here are more features that make the CenTraVac a wise choice for jobs from 45 tons up.

Automatic, unattended operation. Except where required by local codes, there is no need for a special engineer. Push a button to start. From there on the CenTraVac starts, stops and modulates automatically.

No costly multi-level base required. May be set directly on a level concrete floor of sufficient strength to support unit. No foundation bolts required.

Hermetic design. Eliminates need for shaft seals, gear box, heavy thrust bearings and couplings. Minimizes danger of costly refrigerant loss. Eliminates constant supervision and maintenance.

Protection against maintenance and installation errors. CenTraVac has only two main bearings. It is designed to operate only when full oil pressure is applied to both bearings. Compressor is factory aligned, eliminating this problem in the field.

Integral load-limit control. CenTraVac has built-in load-limit control for full protection against overload under all conditions.

Packaged water chiller. CenTraVac is a complete unit. All parts are shipped together including refrigerant and oil charge. Installation requires a minimum of time.

Inspect a CenTraVac installation

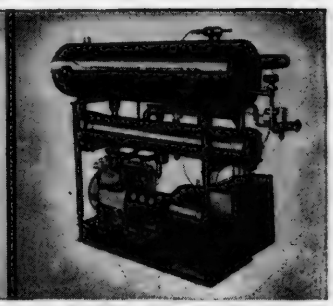
Your local TRANE Sales Representative will be pleased to arrange for you to see a CenTraVac in operation. Simply give him a call. For further data on the CenTraVac—including features, mechanical and engineering specifications, capacities, controls and roughing-in dimensions—contact your TRANE Sales Representative or write TRANE, La Crosse, Wis., for 42-page CenTraVac Bulletin DS-399.

OTHER TRANE AIR CONDITIONING EQUIPMENT FOR JOBS OF ALL SIZES

Reciprocating Compressors . . . cap. up to 50 tons. Automatic cylinder unloading saves power, permits multistep operation to 25% capacity.

UniTrane room units utilize chilled or heated water. Individually controlled for year-round air conditioning. Cabinet or recessed models.

Climate Changers . . year-round air conditioners that heat, cool, humidify, dehumidify, filter and circulate air. Capacities: 450 to 22,000 cfm.



Cold Generators . . . packaged water chillers. Completely wired, piped, charged and tested at factory. Six sizes from 10 to 50 h.p.

TRANE

Manufacturing Engineers of Air Conditioning, Heating and Ventilating Equipment

The Trane Company, La Crosse, Wis. • East. Mfg. Div., Scranton, Penn. • Trane Co. of Canada, Ltd., Toronto • 87 U.S. and 14 Canadian Offices

MAGIC CITY SHOPPING CENTER in Barberton, Ohio, has over three dozen retail stores plus doctor's and dentist's offices, bank, bowling alley. Many use a heating unit in conjunction with G-E Cooling to provide year-round comfort.

SOLVED: 5 Major Problems in Air Conditioning a Shopping Center

In new $3,500,000 Ohio shopping center, the air conditioning contractor reports that G-E Packaged Air Conditioners saved money, saved space, reduced installation time, cut maintenance... provided amazing flexibility to fit *any* job, *any* situation.

SAVED $10,000 IN ONE APPLICATION.
In one of the largest stores, the contractor reports that installation of G-E Packages made possible savings of about $10,000 compared to the estimate for a conventional central system. Yet these units are operating as a central system with ductwork!

REDUCED INSTALLATION TIME BY 30%.
In both in-space and out-of-space applications, G-E units help cut estimated installation time by almost a third. Savings can be even greater for air conditioning an existing structure!

SAVED VALUABLE FLOOR SPACE.
Builder reports that, in many installations, the application of compact G-E Packaged Air Conditioners increased useful floor area. Some store owners feel G-E units pay for themselves in this way alone!

35% CUT IN ESTIMATED MAINTENANCE COSTS.
No refrigeration lines, seals to check, no motor lubrication needed. Installing contractor Max Weisbrod, of Refrigeration Distributing Co., Inc., of Canton, Ohio, figures savings of at least 35% in upkeep.

FIT EVERY APPLICATION.
Units are used in-space, out-of-space, on the selling floor, in the basement, in the storeroom, in large stores, small stores, with and without heating units and cooling towers. They range in capacity from 3 to 15 tons with a total of about 450 tons of G-E Cooling in the entire project.

G-E 5-year Warranty big factor in the equipment selection. Factory-sealed and tested, G. E.'s sealed-in-steel cooling unit is so trouble-free that G. E. provides 5 years' protection on the entire refrigeration cycle.

To find out how you can use G-E units profitably, call your G-E dealer today or write to General Electric Company, Commercial Products Department, Sec. HV-1, Air Conditioning Division, Bloomfield, N. J.

MR. RUSSEL POLAK, who conceived and built this center, says: "We selected General Electric Packaged Air Conditioners because of the large savings gained. Also, the diversity of placement made packaged units more practical for us."

F. W. WOOLWORTH store uses five 7½-ton G-E units in-space for flexibility in placement, absence of ductwork and ease in zone control adjustment.

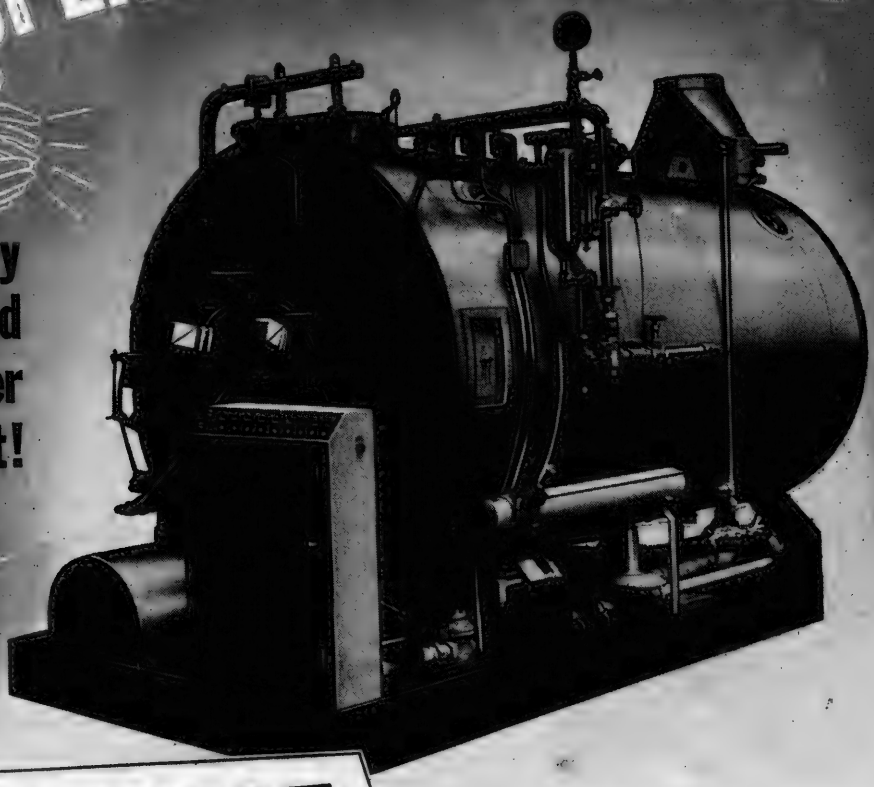
W. T. GRANT uses three 15-ton units and one 10-ton unit as a central system in the mezzanine with another 15-ton unit in the basement.

Packaged AIR CONDITIONERS
for business and industry

GENERAL ELECTRIC

SUPERB PERFORMANCE

on every heating and power assignment!



TITUSVILLE TICOSTEAM

PACKAGE STEAM GENERATOR

For factories, stores, hospitals, apartments, office buildings—wherever high-efficiency heating and power are a special consideration—specify and install TICOSTEAM for dependable satisfaction! A complete steam plant, equipped with every safety feature, this outstanding unit is *Titusville* in top quality and performance on the job. Request our descriptive Bulletin B-3100.

For light oil, and light oil and gas

Heavy oil, and heavy oil and gas

Natural or manufactured gas

TITUSVILLE IRON WORKS CO TITUSVILLE, PA.

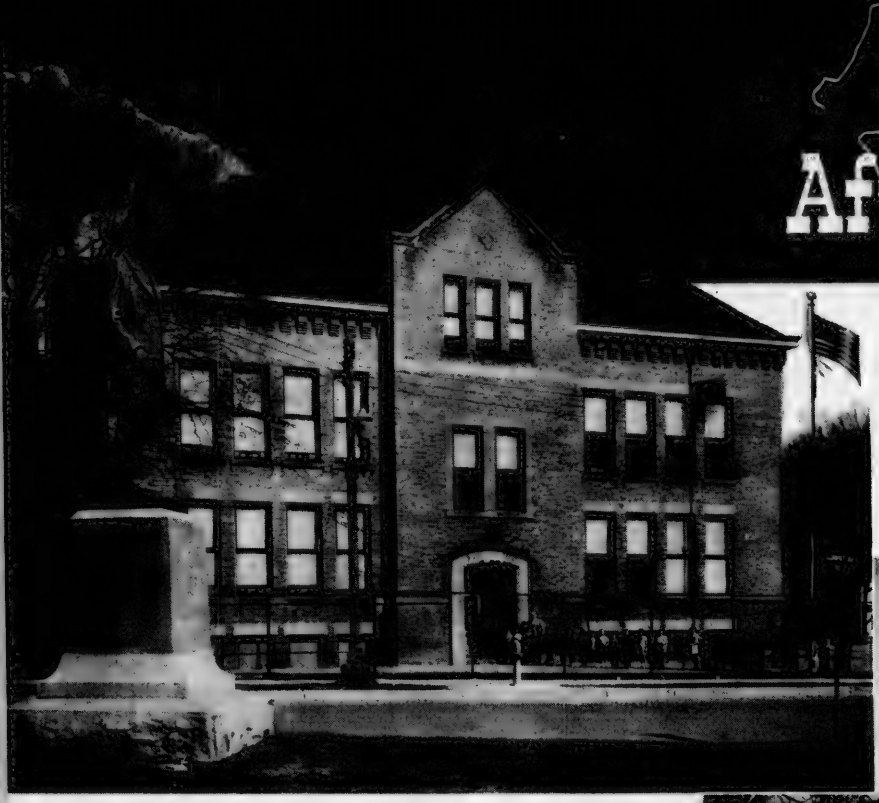
A DIVISION OF Struthers Wells

THE TITUSVILLE IRON WORKS COMPANY

TITUSVILLE, PENNSYLVANIA

Manufacturers of A COMPLETE LINE OF BOILERS FOR EVERY HEATING AND POWER REQUIREMENT

After 50 Years th



LINCOLN SCHOOL
RACINE, WIS.
POWERS TEMPERATURE CONTROL
Installed here in **1903**

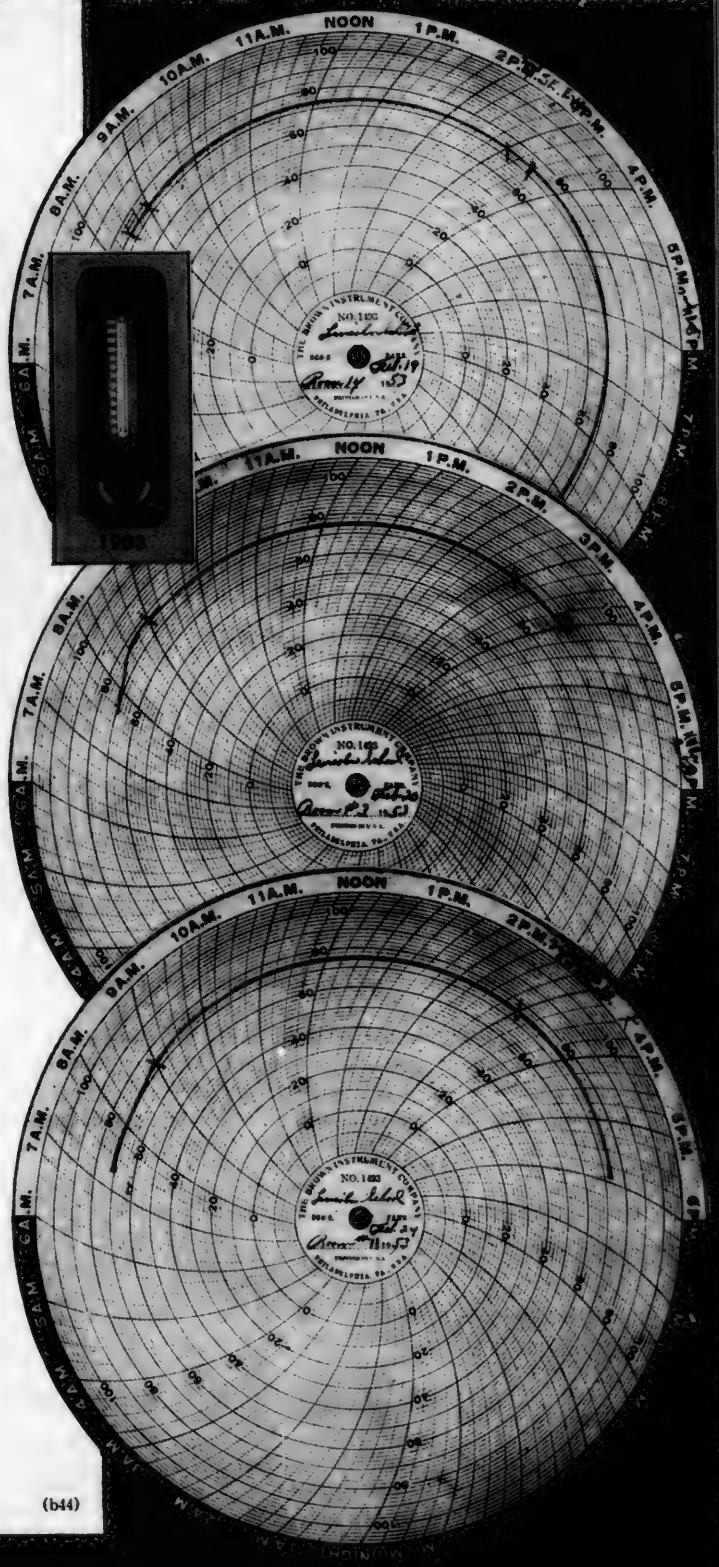
Above: One of a number of old and modern schools in RACINE equipped with Powers Control.

Below: RACINE'S New JERSTAD-AGERHOLM SCHOOL Completed in 1952 is also Powers controlled. Only a portion of the building appears in the photo. It has 14 classrooms, an administration and community center, playroom and kitchen, and audio-visual room. It is attractive inside and out—heating and ventilation are maintained with utmost economy.

Architects and Engineers: WARREN S. HOLMES CO., Lansing, Mich.
Heating Contractor: N. A. THOMAS CO., Racine, Wis.

s this test shows POWERS

Pneumatic System of TEMPERATURE CONTROL IS STILL GIVING ACCURATE REGULATION



Miss K. Mart, Teacher in Room 14 Lincoln School, Racine, Wis. "T" is POWERS *Type A* Thermostat installed in 1903. It controls mixing dampers. Thermostat was set for 75° F. Note even control during schools hours. "RT" is Recording Thermometer which made charts at right in February 1953.

How is it possible for Powers systems to often give 25 to 50 years of dependable service?

Since 1891 outstanding features of a Powers thermostat have been: its powerful VAPOR-DISC with GRADUAL-ACTION and its famous non-bleed double valve. Proof of its superiority is revealed in the performance record shown here—as well as in many other old schools.

To get more years of better performance, greater comfort and fuel economy — install a POWERS pneumatic system of temperature control.

(b44)

THE POWERS REGULATOR COMPANY

SKOKIE, ILLINOIS

OFFICES IN OVER 50 CITIES IN U.S.A., CANADA AND MEXICO • SEE YOUR P..ONE BOOK

60 YEARS OF AUTOMATIC TEMPERATURE CONTROL

from the **Simplest** Single Pipe System...

to the most **Complex** Multiple Pipe Installation...

"Z"crete®

THE MODERN MONOLITHIC INSULATION

Pouring Z-Crete Insulation into forms for single pipe system to provide an insulated conduit that is strong, resilient, compact and efficient.

Conduit containing 10 pipes in typical installation. Pipes anchored to base, support blocks in place prior to pouring of Z-Crete. Low cost construction.

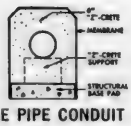
Insulates underground heated piping *easier, economically, permanently!*

No pipe arrangement too tough for this versatile insulation! Z-CRETE affords permanent insulating efficiency—forms a safe, solid monolithic protection around one pipe or a *dozen* in the same conduit . . . without joints or voids. Hundreds of thousands of feet of Z-CRETE have been installed in all parts of the country and in all types of soil conditions. Any number, size or arrangement of pipes can be designed into a Z-CRETE conduit. Made of inorganic, rotproof, insulating concrete—monolithic pour assures restricted water movement around the assembly. And you'll find it's usually the most economical system to install. Write for complete details today!

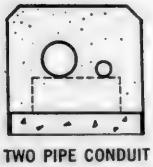
No Other Insulation for Underground Piping Offers All These Superior Advantages!

- **More Adaptable**—Z-Crete is entirely a field fabrication. No pre-formed sections are required.
- **More Economical**—Low in cost, provides permanent and stable insulation. Especially economical in large pipe or multiple pipe conduits.
- **More Efficient**—Six inches of insulation around piping provides plus insulation value—eliminates heat loss due to air movements.
- **Permanent**—Will not rot or deteriorate, water-resistant. It's resilient, completely fireproof.
- **Readily Available**—No critical materials required. Experienced, licensed applicators, located in all parts of the country, are ready to serve you.

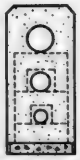
FOR ANY HEATED UNDERGROUND SYSTEM



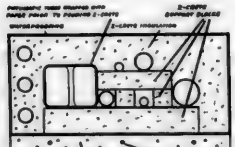
SINGLE PIPE CONDUIT



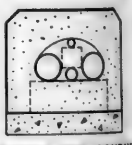
TWO PIPE CONDUIT



PIPE OVER PIPE



MULTIPLE PIPE CONDUIT



MULTIPLE PIPE CONDUIT WITH STEAM TRACER

"Z"crete® DIVISION

ZONOLITE COMPANY

135 So. LaSalle Street • Chicago 3, Illinois

Z-Crete is furnished and installed only by licensed applicators of Zonolite Company under U. S. Patent No 2355966—Canadian Patent No. 439356

WRITE FOR FREE BOOKLET!

Z-CRETE DIVISION,
ZONOLITE COMPANY
Dept. HV-24
135 S. LaSalle St., Chicago 3, Ill.

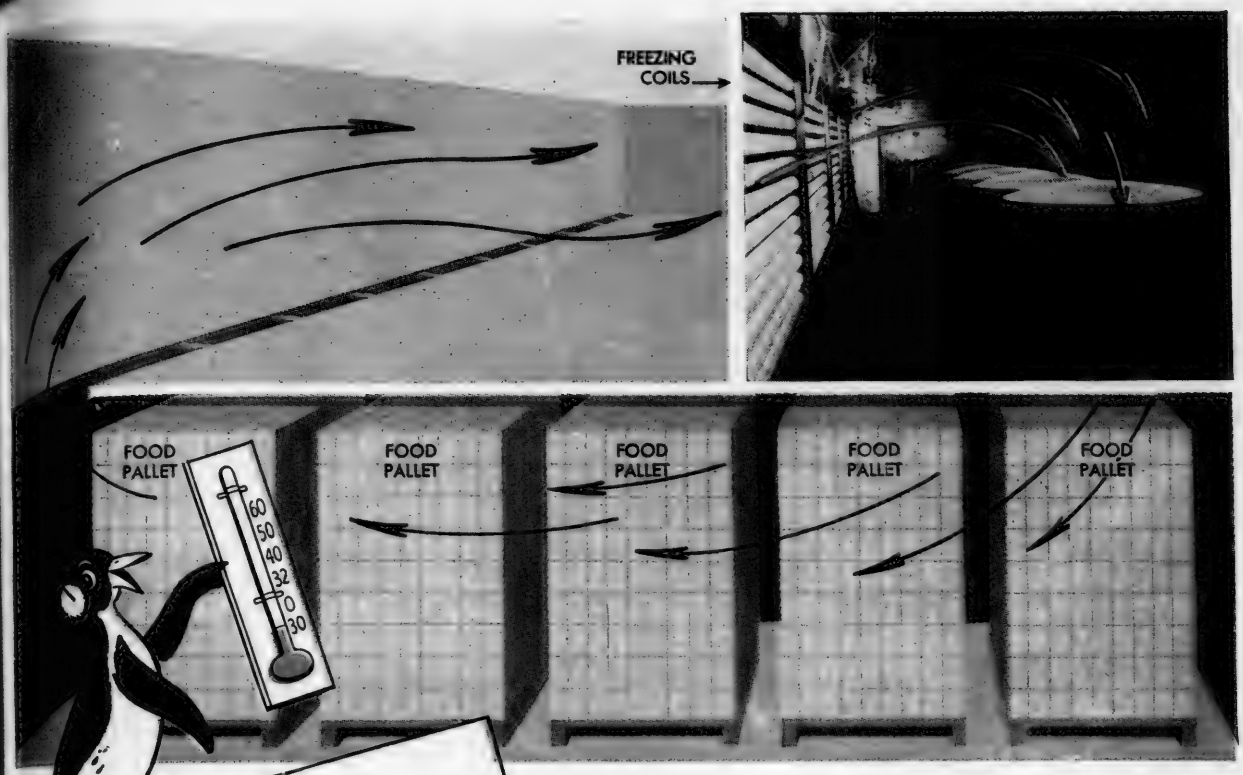
Please send FREE Z-Crete Booklet with full details and specifications about this easier, better insulation of underground heated piping.

Name.....

Company.....

Address.....

City.....Zone.....State.....



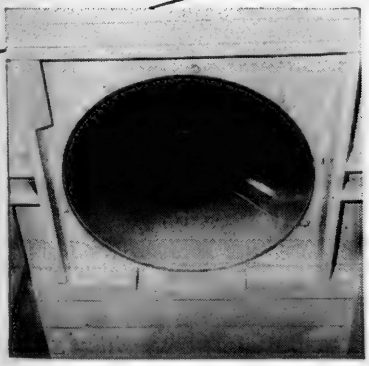
JOY
® AXIVANE FANS HANDLE SEVERE QUICK-FREEZE JOB

A West Coast quick-freezing plant boasts an effective operation that utilizes 24 Joy 7½ HP Series 1000 Axivane Fans, installed in two groups of 12 each.

Note the illustration above. The upper floor contains freezing coils and a row of 12 fans. The floor below is partitioned into narrow freezing tunnels, each served independently by a single Joy fan.

As air passes through the freezing coils, it is cooled to between —30° and —35°. This sub-zero air is propelled down and through the tunnels below, which contain pallets of meat, vegetables, fruit, etc. to be quick-frozen. After passing over the food, the air is again cooled and circulated. At full plant load, each 12-fan battery handles 242,000 CFM of air.

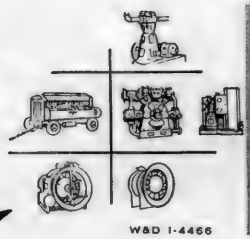
The relatively quiet operation, light weight, compactness and low power consumption of Joy Axivane Fans—due to the unmatched efficiency of their vaneaxial design—have proved *real* advantages on this job. Their in-line construction also saves space, since each fan can be mounted right in its short, vertical duct. In addition, extreme flexibility of operation is made possible by the adjustable blades, a standard Joy feature. ● Let us help you to get best results on your fan problems. ***Joy Manufacturing Company, Oliver Bldg., Pittsburgh 22, Pa.*** In Canada: *Joy Manufacturing Company (Canada) Limited, Galt, Ontario.*



Left: Looking up from the quick-freeze room below a Joy Axivane Fan. Note the compact, economical use of space and the simple mounting.

Consult a Joy Engineer

for Vaneaxial Fans . . . Compressors, Vacuum Pumps and Boosters . . . Oxygen Generators



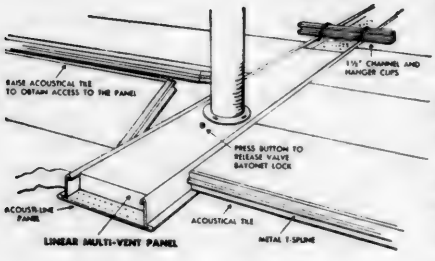
W&D 1-4466

JOY

SPECIALISTS IN THE COMPRESSION AND MOVEMENT OF AIR AND GASES SINCE 1906

new! *Out-of-sight* AIR DIFFUSERS for acoustical block ceilings!

Now Pyle-National Multi-Vent® air diffusing panels, adapted for concealed installation in Celotex Acousti-Line ceilings, provide advantages heretofore possible only with metal pan.


RAISE ACOUSTICAL TILE TO OBTAIN ACCESS TO THE PANEL
1½" CHANNEL AND HANGER CLIPS
PRESS BUTTON TO RELEASE VALVE BAYONET LOCK
ACOUSTI-LINE PANEL
ACOUSTICAL TILE
LINEAR MULTI-VENT PANEL
METAL T-SPLINE

The perforated face of Acousti-Line metal suspension panels act as diffusing plates for Multi-Vent units. No special supports are needed. Flexible connection minimizes need for accurate alignment between duct opening and Acousti-Line panels.

Note ready access to Multi-Vent unit for cleaning or valve adjustment.

NEW SMUDGE-FREE OPERATION—Multi-Vent's low velocity air delivery eliminates the dirtying or discoloration of adjacent acoustical blocks, a costly maintenance problem with high velocity diffusion.

NEW BEAUTY—Out-of-sight installation eliminates all protruding outlets and unsightly grilles. Permits complete freedom of interior design and decoration.

NEW LOWER INSTALLATION COST—Multi-Vent units can be assembled, connected to the duct, and seated in the metal suspension panels in just a few seconds. No tools are required . . . no cutting of blocks necessary.

AND, MOST IMPORTANT OF ALL—Air distribution by Multi-Vent's gentle pressure displacement assures perfectly even air motion and exceptional uniformity and control of room temperatures. The total absence of strong air streams or blow eliminates all usual sources of draft complaints and permits complete freedom in relocating partitions.

For complete information about Multi-Vent installations for all types of ceilings consult the Pyle-National Sales Engineer in your vicinity, or write direct.

MULTI-VENT DIVISION
Sales and Engineering Representatives in Principal Cities of United States and Canada

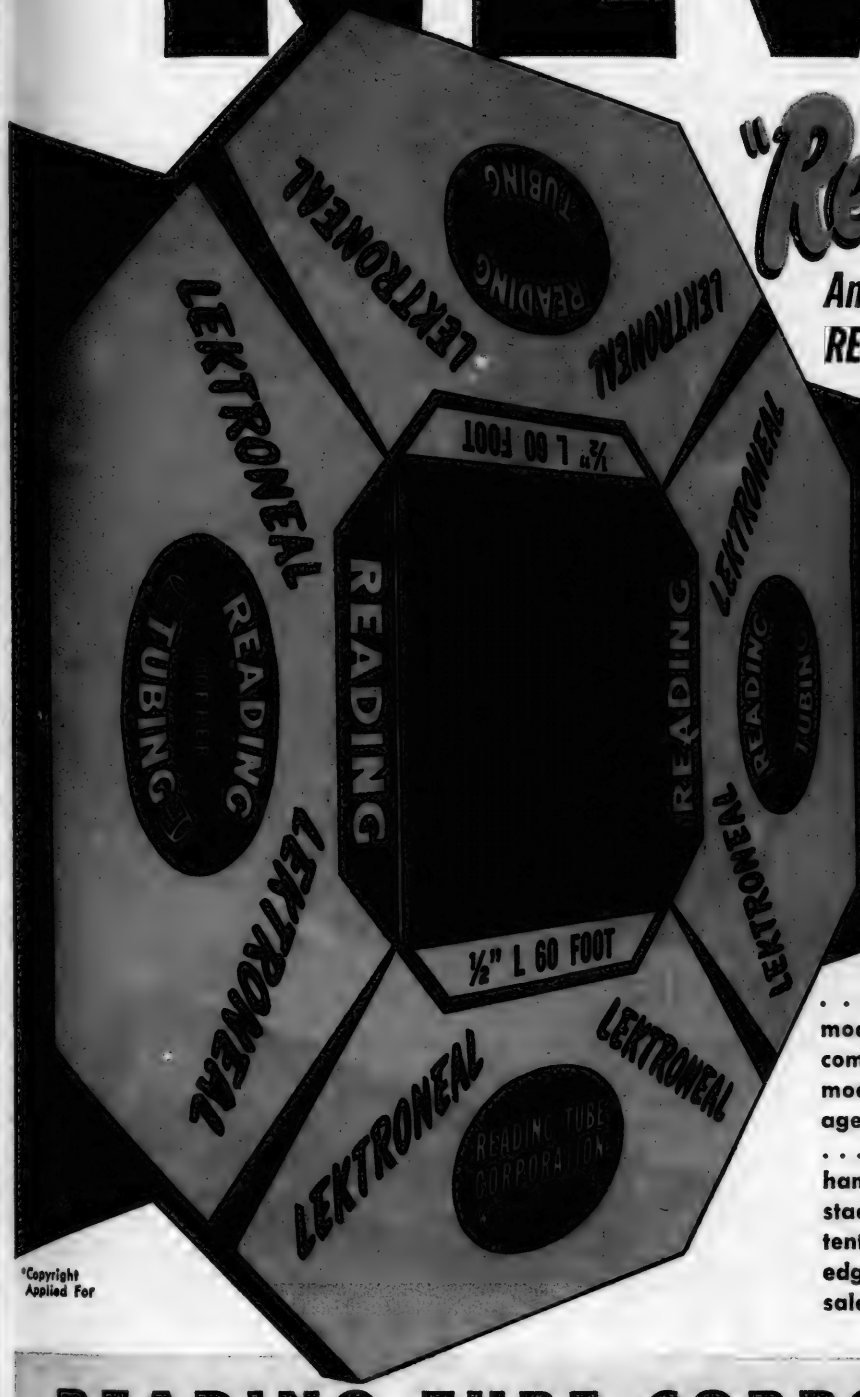
THE PYLE-NATIONAL COMPANY
1374 North Kostner Avenue Chicago 51, Illinois

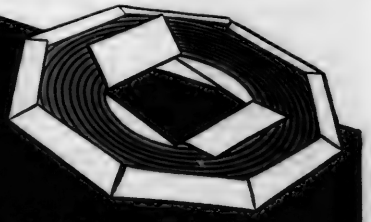
TURBO-GENERATORS • FLOODLIGHTS • PLUGS AND RECEPTACLES • CONDUIT FITTINGS

NEW

"Readi-Pak"*

Another BIG PLUS for READING COPPER TUBE...





- Complete Protection!
- Easier to Handle!

*Copyright Applied For

Reading copper tube . . . produced in America's most modern copper tube mill . . . now comes packed in the industry's most modern container. Individual package is ready for job or re-shipping . . . no half-filled master cartons to hamper inventory. Readi - Pak* stacks or hangs compactly. Contents clearly labeled on sides and edges. Makes a colorful point-of-sale display, too!

READING TUBE CORPORATION

Producers of Reading Lektroneal Copper Tube and Reading 85% Grade A Red Brass Pipe

READING COPPER TUBE

Sold Exclusively Through Plumbing & Heating Supply Wholesalers

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Empire State Building, New York 1, N. Y.
OXford 5-1500
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DISTRIBUTION DEPOTS:
- Reading, Pa.
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- Chicago, Ill., 724 W. 50th St.
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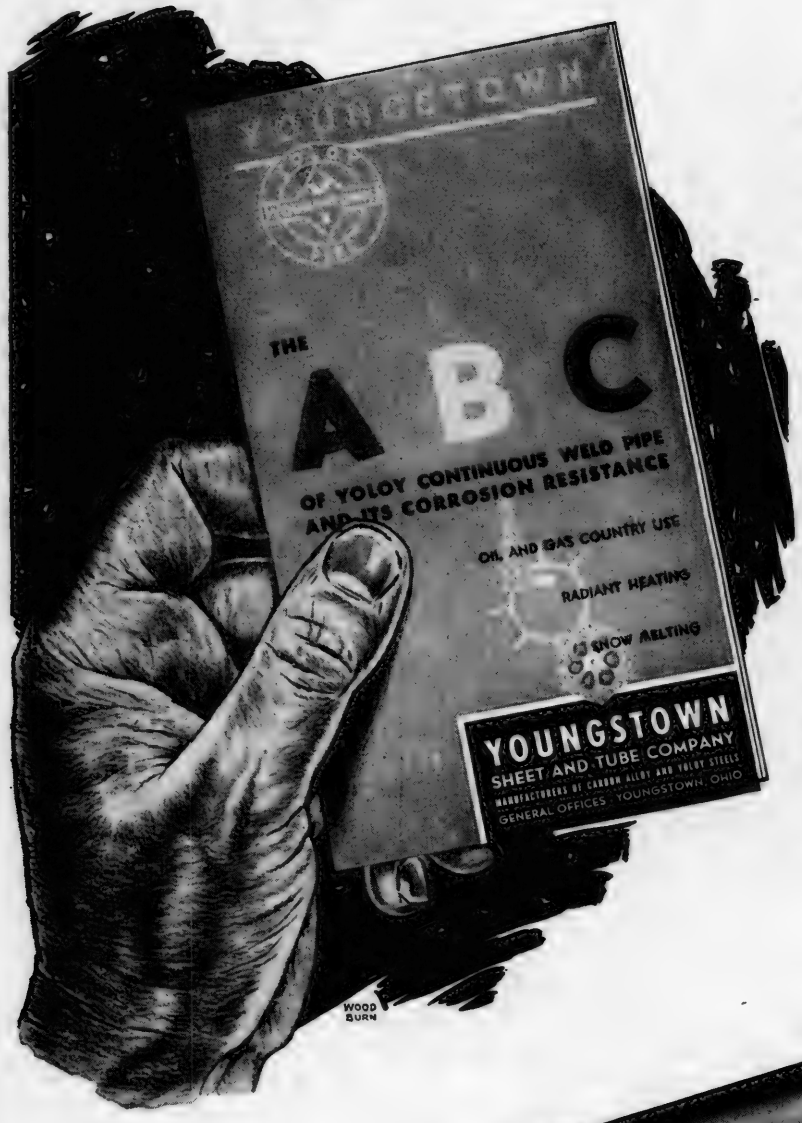
- Atlanta, Ga., 690 Murphy Ave., S. W. Unit 5, Bldg. B.

This DATA may solve YOUR piping problem



● Here is the up-to-date story of Yoloy Continuous Weld Pipe—a remarkable low alloy steel whose nickel-copper content gives it unique ability to withstand corrosion, abrasion and shock. These outstanding advantages combined with high strength, ductility and weldability make Yoloy Pipe an excellent selection.

Proved by 18 years of satisfactory performance, Yoloy is highly recommended by users in such service as radiant heating, snow melting, gas line gathering, brine lines and other industrial piping.

This new folder presents the facts and figures on Yoloy's physical and chemical properties, with data on sizes now available and other information you'll need to select Yoloy Continuous Weld Pipe to meet your special requirements. Write for a copy today.

Youngstown

QUALITY YOUNGSTOWN SERVICE

THE YOUNGSTOWN SHEET AND TUBE COMPANY General Offices Youngstown

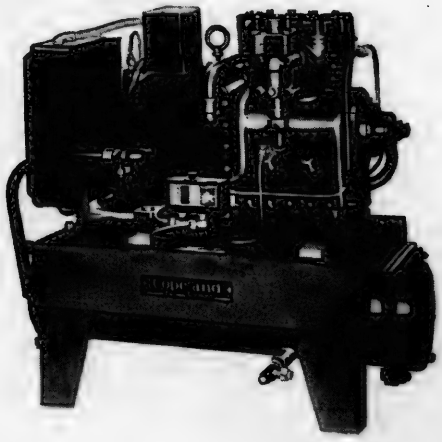
Manufacturers of Carbon, Alloy and Yoloy Steel

Export Office 500 Fifth Avenue, New York

COLD FINISHED CARBON AND ALLOY BARS · ELECTROLYTIC TIN PLATE · COKE TIN PLATE · WIRE · PIPE
TUBULAR PRODUCTS · CONDUIT · RODS · SHEETS · PLATES · BARS · RAILROAD TRACK SPIKES

COPELAMETIC

THE *Accessible* HERMETIC

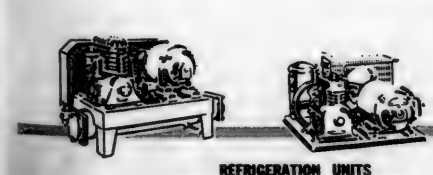


fits into any air conditioning plan

Cutaway of 7½ H.P. COPELAMETIC Motor-compressor

Whether it's a room air conditioner, a large package unit or a huge factory system, COPELAMETIC is your answer to the question "Which refrigeration unit shall I recommend for the air conditioning system?" COPELAMETIC has become the standard of comparison for dependability, ruggedness, compactness and long life. Your clients will appreciate the COPELAMETIC design which eliminates belts, seals and manual oiling . . . reasons for 9 out of 10 service calls. Better yet, they'll appreciate the practical feature of accessibility.

Air-cooled, remote COPELAMETICS are built from ¼ thru 3 HP. There are also water-cooled, remote units from ⅓ thru 7½ HP. Self-contained COPELAMETICS are available for all applications. Write for Condensed Catalog C-52.



REFRIGERATION UNITS
(OPEN TYPE AND COPELAMETIC)
WATER COOLERS

Copeland
DEPENDABLE *Electric* REFRIGERATION

COPELAND REFRIGERATION CORPORATION, SIDNEY, OHIO

why worry?

INSTALL Petro HEATING OR POWER EQUIPMENT

and be sure!

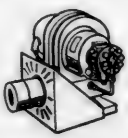
Petro equipment has a well earned 51-year reputation for dependable, economical service

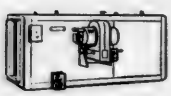
OIL AND GAS FURNACES AND BOILERS

Complete winter air conditioners built in popular sizes to fit the heating needs of homes from 4 to 10 rooms. Real fuel-savers.

OIL CONVERSION BURNERS

Oil burners for residential use. Commercial and industrial oil, gas, and combination oil-gas burners. Residential oil burner illustrated.



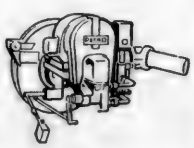


HORIZONTAL OIL FURNACE

Hang it or hide it—this winter air conditioner fits anywhere. Available in 5 models from 80,000 to 180,000 Btu's (output at bonnet).

INDUSTRIAL OIL BURNERS AND OIL-GAS COMBINATION BURNERS

Rotary type. Burn low-cost, heavy fuel oil with complete reliability. Models for every industrial need. Capacities up to 200 gallons per hour. Combination oil-gas models are available.

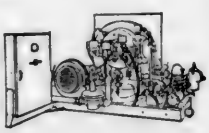


INDUSTRIAL GAS BURNERS

Vertical type, readily adaptable to any conventional boiler. Zone fire enables low-fire start and modulated firing. Capacities 6 to 500 boiler hp.

COMPLETE "PACKAGED UNITS" FOR OIL, GAS OR BOTH

A complete combustion system in which all elements are completely balanced and integrated. Control panel factory wired and tested. Saves installation time and cost—gives top performance.



COMPLETE LINE

With Petro equipment you *know* that you can get the exact size and model that you need—for any residential, commercial, or industrial installation.

SIMPLE, DEPENDABLE OPERATION

Petro oil and gas burners cost the boiler plant operator or home owner less to own and operate because their performance is proved and simple. The fine reputation Petro equipment enjoys, and its popularity with owners, is the result of this simplicity and traditional dependability.

EASILY INSTALLED

Petro oil and gas burners are compact and well built. Heavy mounting flanges, protected wire connections, easy access to fuel and ignition lines, are all features which help make Petro oil and gas burners the favorite of contractors and dealers everywhere. These features save installation time and cut service calls.

LOW FUEL COST

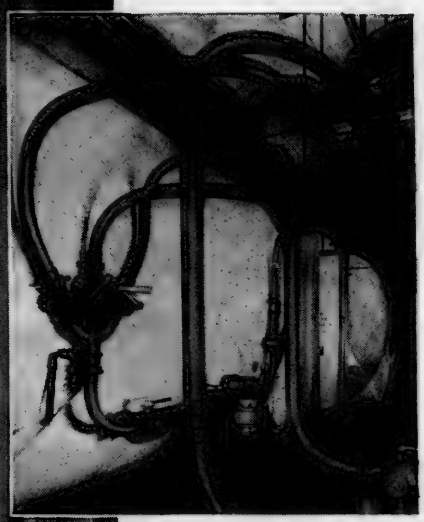
Stingy with fuel and generous with comfort—that's the story of Petro equipment. The result is satisfied customers who recommend you and Petro equipment to their friends. Write for complete information and specification sheets, 3048 West 106th St., Cleveland 11, Ohio. In Canada: 2231 Bloor Street West, Toronto, Ontario.

Residential Oil and Gas Burners, Oil and Gas Furnaces and Boilers, Industrial and Commercial Oil, Gas and Oil-Gas Combination Burners

PETRO

T. M. REG. U. S. PAT. OFF.

OVER 50 YEARS OF LEADERSHIP IN AUTOMATIC HEATING AND POWER EQUIPMENT



FINISHED BEER is fed through 2-in. ANACONDA Copper Tubes to bottling room.

PUMPING ROOM of Liebmann Breweries, Inc., Brooklyn, N. Y. Notice the smooth bends and braze into main line (at top of picture). These are the kinds of savings you get with ANACONDA Copper Tubes.

VERSATILE COPPER:

Efficient, economical piping for brewers of Rheingold Beer

In the pictures above you'll find numerous reasons why ANACONDA *Copper Tube* pipelines are *economy* pipelines. They adapt easily to any plant layout and equipment. Long lengths of lightweight ANACONDA Copper Tubes speed assembly, too. They may be bent so you can clear beams, girders and other obstructions—without extra joints and fittings. And fewer fittings mean less flow resistance, lower pumping costs. ANACONDA Copper Tubes with solder-type fittings also permit you to make sound, economical connections. You can also dismantle and reassemble *copper* tube lines easily to meet changing plant conditions.

ANACONDA Copper Tubes are strong, rustproof and corrosion-resistant. They remain smooth and clean inside.

For reliable service on ANACONDA Copper and Copper Alloys—consult your Anaconda Distributor.

Write for free booklet, "ANACONDA Copper Tubes for Industrial Applications" to *The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont.* 5332 (Rev.)

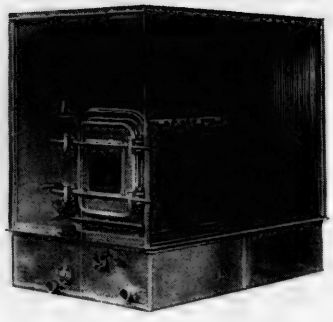
ANACONDA®

Makers of copper tubes for industrial processing, water, heating, soil, waste and vent lines; welding rods; flexible metal hose and tubing; heat exchanger tubes; bus conductors; sheet copper; refrigeration products.

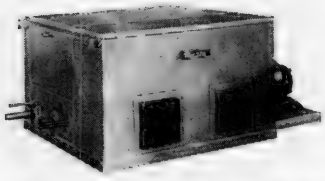
General Contractor:
George Hyman Construction Co.,
Washington, D.C.

Architects:
Porter and Lockie, Washington, D.C.

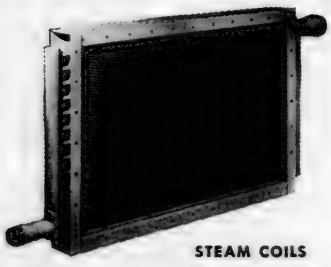
This project is being constructed under the supervision of the Washington District, Corps of Engineers.



SPRAY TYPE DEHUMIDIFIER



CEILING TYPE AIR CONDITIONING UNIT



STEAM COILS

Marlo EQUIPMENT

provides year-round air conditioned comfort in U. S. Soldier's Home Auditorium

Every facility for comfort and efficiency has been incorporated in the new Domiciliary Building of the U. S. Soldier's Home in Washington, D. C. . . . including complete year-round air conditioning in the auditorium.

Modern Marlo equipment, which serves so many buildings in the Washington area, was installed for this important comfort-conditioning job. Marlo air conditioning units, spray type dehumidifier, steam coils and pan humidifiers provide a pleasant living atmosphere for residents of this handsome structure.

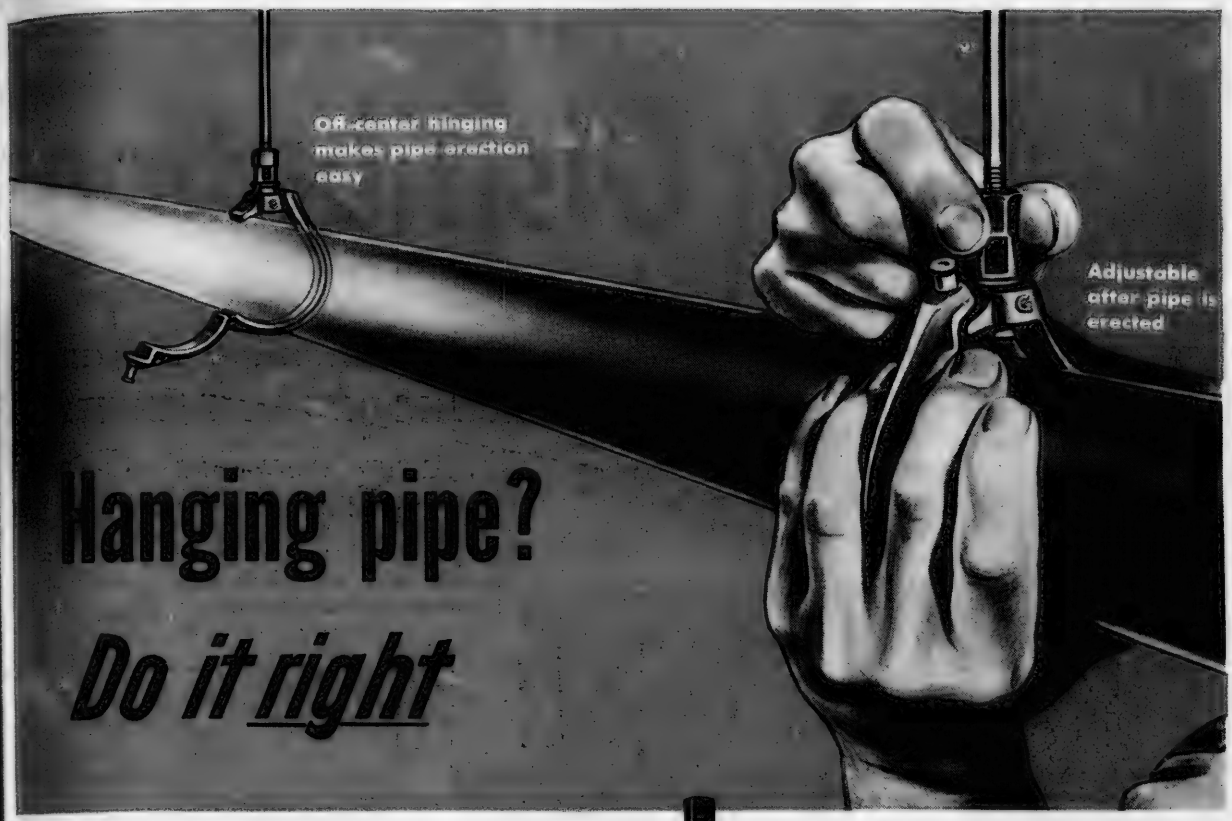
Marlo equipment is designed to serve any air conditioning need . . . better!

FOR INFORMATION ON THE COMPLETE MARLO LINE, WRITE TO MARLO TODAY

Marlo COIL COMPANY

Manufacturers of COOLING TOWERS • EVAPORATIVE CONDENSERS • INDUSTRIAL COOLERS • AIR CONDITIONING UNITS • MULTI-ZONE UNITS • BLAST HEATING & COOLING COILS

Saint Louis 10, Missouri



Hanging pipe?

Do it right

There's a stock Grinnell hanger for every piping requirement

SAVE MONEY ON ASSEMBLY. Cut installation time, get better, stronger installations, with Grinnell adjustable pipe hangers and supports.

NO SAG . . . NO WATER TRAP. Grinnell hangers permit adjustment after pipe is installed. This makes it possible to prevent sagging pipe and water traps, and assures positive drainage for the entire system.

FOR EVERY INSTALLATION. There is a stock Grinnell hanger for every need from simple water pipe to high pressure, high temperature steam line. Where necessary, there is a hanger to compensate for thermal movement.

PLAY SAFE. Don't waste time or take chances on inadequate pipe hangers and supports. All Grinnell hangers comply with rigid piping code requirements.

Enlarged section showing locking feature

GRINNELL ADJUSTABLE SWIVEL PIPE RING
(Split Ring Type)

- Hinging of ring is off-center. This provides sufficient seating to hold pipe before closing ring. Wedge-type pin is loosely but inseparably cast into the hinged section for fastening after pipe is in place.
- To obtain proper adjustment, swivel shank can be turned easily by hand when the weight of the pipe is temporarily taken off the ring.
- When weight is returned, patented swivel shank locks automatically, preventing change of adjustment due to vibration. Wire retaining ring keeps swivel shank and pipe ring or yoke from separating, makes assembly a single unit.
- 12 sizes have load range of 80 lbs. for ¾" size to 1510 lbs. for 8" size. May be used in connection with practically any building attachment.

GRINNELL

AMERICA'S #1 SUPPLIER OF PIPE HANGERS AND SUPPORTS

Grinnell Company, Inc., Providence, Rhode Island • Coast-to-Coast Network of Branch Warehouses and Distributors

Manufacturer of: pipe fittings • welding fittings • forged steel flanges • steel nipples • engineered pipe hangers and supports
Thermolier unit heaters • Grinnell-Saunders diaphragm valves • prefabricated piping • Grinnell automatic fire protection systems

BARBER COLMAN

"UNI-FLO" ENGINEERED

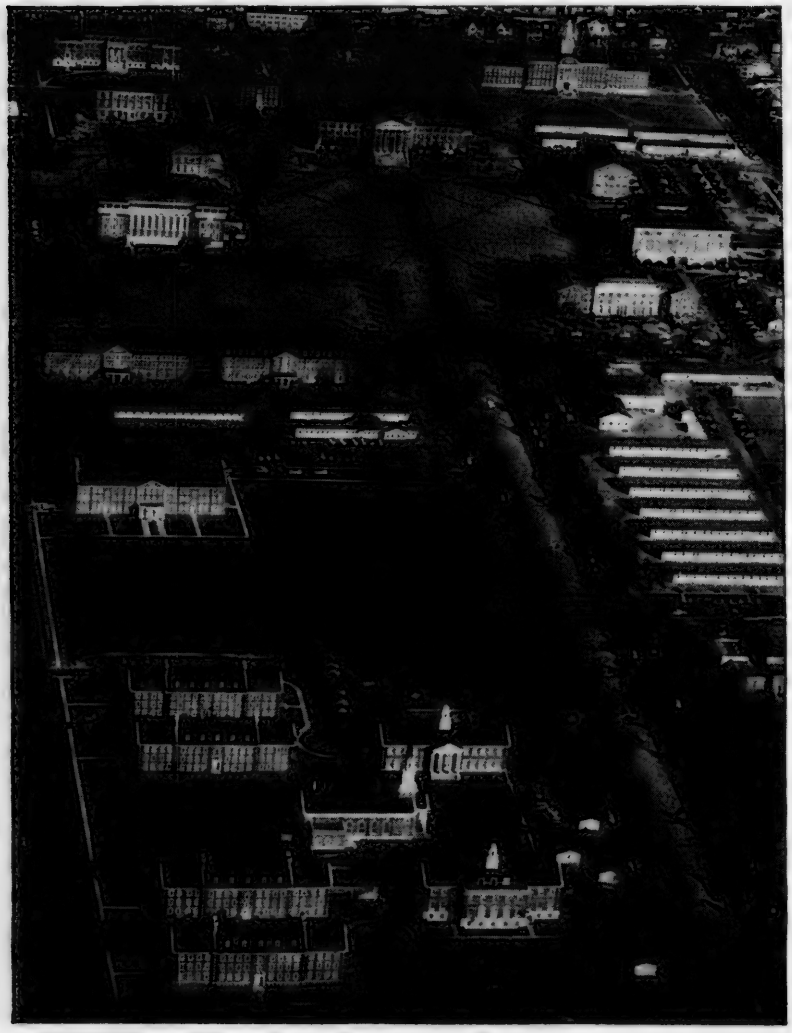
Air Distribution

. . . plays important role in air conditioning old and new buildings at SOUTHERN METHODIST UNIVERSITY!

First major university to initiate a comprehensive program for air conditioning classrooms, Southern Methodist University now has comfort cooling in eleven buildings. Another air conditioned building is under construction, two are proposed, and the application of air conditioning to four existing buildings is under consideration for the Dallas institution.

Based upon performance in early installations, thousands of Barber-Colman Uni-Flo Wall Diffusers and Grilles, plus Venturi-Flo Ceiling Diffusers are now providing a healthful, comfortable, draft-free atmosphere for students and faculty. The complete story on finest air distribution equipment made is available from your nearby Field Office or by sending coupon below.

Architect: Mark Lemmon. Consulting Engineers: Zumwalt & Vinther, J. W. Lacy. General Contractors: Henger Construction Co., Robert E. McKee, O'Rourke Construction Co. Air Conditioning Contractors: C. Wallace Plumbing Co., Farwell Co., Martyn Brothers, Inc.

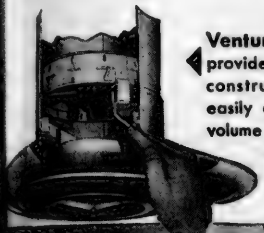


Aerial view of the impressive campus, scene of an enormous postwar building program. Under the leadership of Dr. Umphrey Lee, president, the University has grown rapidly in educational stature as well as in modern housing.

Double Deflection "MA" Sidewall Diffusers were specified for many applications. Features include integral volume control, easily removed cores, rapid diffusion, low noise level.

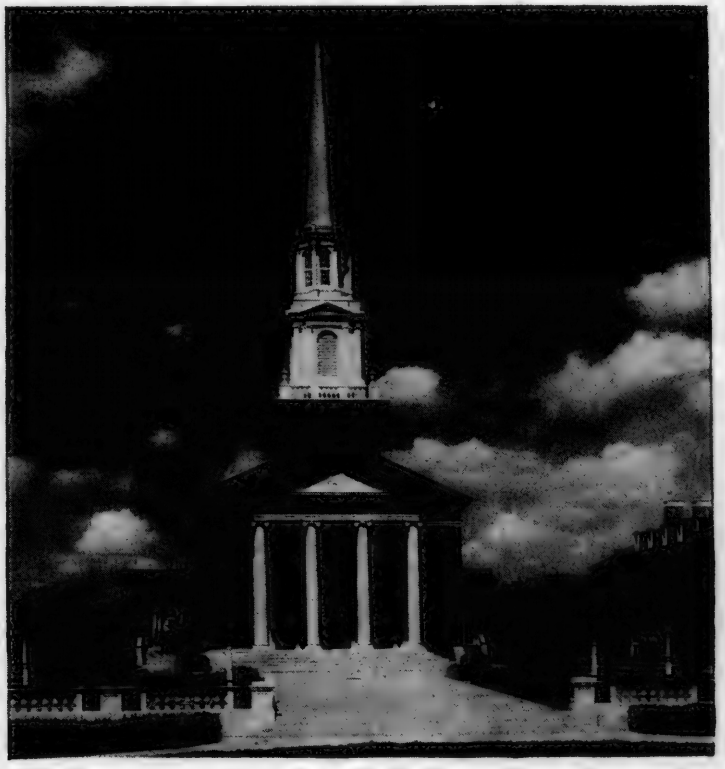
Fondren Science Building one of the most modern in the nation, located on North Campus. 224 Uni-Flo Sidewall Diffusers and Venturi-Flo Ceiling Diffusers distribute air evenly, quietly.

Bridewell Library, Perkins Quadrangle. In this building alone are 141 Uni-Flo Sidewall Diffusers and 63 Venturi-Flo Ceiling Diffusers, all equipped with Volocitrols in supply duct approaches.



Venturi-Flo Ceiling Diffusers provide efficient diffusion, rigid construction, quiet operation, easily adjustable deflection and volume control in units noted for attractive, modern design.

Classroom in Kirby Hall, Perkins Quadrangle. In this new Quadrangle, seven new buildings have been equipped with Barber-Colman Air Distribution products since 1950.



Perkins Chapel where 34 Uni-Flo and Venturi-Flo units assure quiet comfort. Similarly equipped is Highland Park Methodist Church located on the campus—one of the nation's largest Methodist Churches.

BARBER COLMAN

"UNI-FLO" ENGINEERED

Air Distribution

BARBER-COLMAN COMPANY, ROCKFORD, ILLINOIS

Air Distribution Products • Automatic Controls • Industrial Instruments
Aircraft Controls • Small Motors • OVERdoors and Operators • Molded Products • Metal Cutting Tools • Machine Tools • Textile Machinery

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LOOK WHAT'S HAPPENING IN YOUR COOLING TOWER

HERE'S WHY KOPPERS PRESSURE CREOSOTING ON HALSTEAD & MITCHELL COOLING TOWERS IS VITAL FOR LONG LIFE

WHY CREOSOTED WOOD?

Rough-cut wood simply "wets" more effectively than any other suitable material. Constantly wetted wood is subject to immediate attack by fungus and marine parasites. Creosote is the most permanent and positive preservative for timber . . . *containing 162 elements* toxic to fungus growth and parasites . . . proved by over 100 years of use. All wood used in Halstead & Mitchell Cooling Towers is pressure-creosoted.

WHY KOPPERS PRESSURE-CREOSOTING?

Wood preservatives must penetrate deeply to be effective; a surface coating can be worn or broken through and the wood is then under immediate attack. Koppers Pressure-Creosoting gives the deepest possible penetration and longest possible life. Therefore, Halstead & Mitchell wetted decks are Koppers Pressure-Creosoted.

ONLY HALSTEAD & MITCHELL OFFERS THE

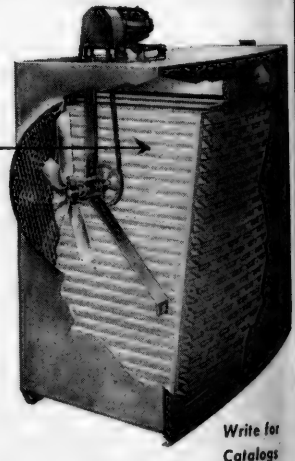
20-Year Guarantee!

ON THE WETTED DECK SURFACE

against rotting by fungus attack

2 thru 100 Tons

Sheet-Steel Cabinets,
3-times protected
Stainless Steel Fans and Shafts
Weather Shielding
Gravity-Type Distributing Pans
—no windage loss
Everdur Bolts for ease of
disassembly at any time.



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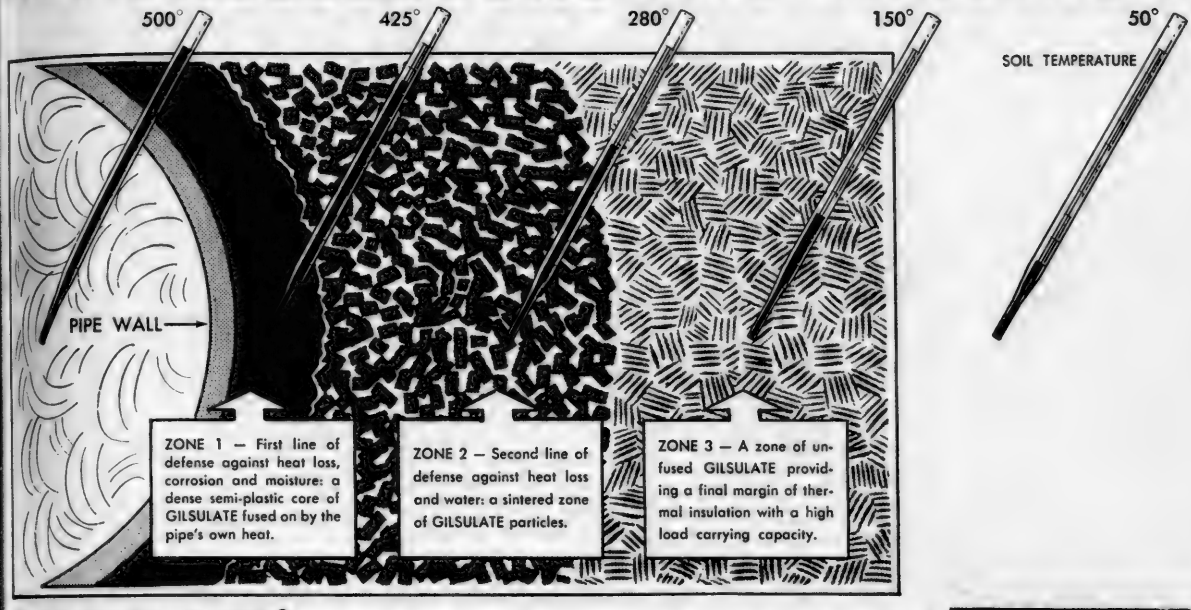
HM Halstead & Mitchell

OFFICES: Bessemer Bldg., Pittsburgh 22, Pa.

Lowest Cost

PER INSTALLED LINEAR FOOT OF ANY HOT UNDERGROUND PIPE INSULATION


500°
425°
280°
150°
50°
SOIL TEMPERATURE
PIPE WALL
ZONE 1 — First line of defense against heat loss, corrosion and moisture: a dense semi-plastic core of GILSULATE fused on by the pipe's own heat.
ZONE 2 — Second line of defense against heat loss and water: a sintered zone of GILSULATE particles.
ZONE 3 — A zone of unfused GILSULATE providing a final margin of thermal insulation with a high load carrying capacity.

GILSULATE®... the triple-zone insulation that fuses itself into lifetime protection for hot underground pipes. Water-proof, corrosion-proof, root-proof, acid/alkali-proof.

Compare your present insulation methods with Gilsulation:

1. Pour Gilsulate granules out of the bag onto the pipe; tamp it down.
2. Backfill: *the job is insulated!*

Gilsulate—nature's own insulation—is a unique, solidified hydrocarbon that virtually installs itself. Normal pipe-heat (up to 520°F) does the rest—fuses the Gilsulate to the pipe in hours, forming a massive circular solidified sheath.

Gilsulate costs less installed per linear foot *than any other underground pipe insulation*... it's easiest to use... and has been tested in scores of the country's largest and most important installations.

Some additional Gilsulate advantages:

- *3 grades available*—220° to 520° F
- *needs no sleeves* or mechanical sheaths
- *requires no mixing* or special handling
- *can't be punctured* — leave rocks in backfill
- *pipe expands and contracts* within Gilsulate structure
- *proved in actual use* in hundreds of new construction and replacement installations

Send coupon for descriptive literature.

AMERICAN GILSONITE COMPANY
SALT LAKE CITY, UTAH
Affiliate of Barber Oil Corp. & Standard Oil Co. of California

No skills necessary—simply pour Gilsulate out of 100 pound bags, tamp and backfill. Can be used under any and all conditions—no matter how many pipes, whatever the space.

GILSULATE®

THE TRIPLE-ZONE INSULATION
FOR LIFETIME PROTECTION
OF HOT UNDERGROUND PIPES.

American Gilsonite Company
134 West Broadway, Salt Lake City 1, Utah
or 1145 East Jersey Street, Elizabeth 4, N. J.

Please send me descriptive literature on Gilsulate.

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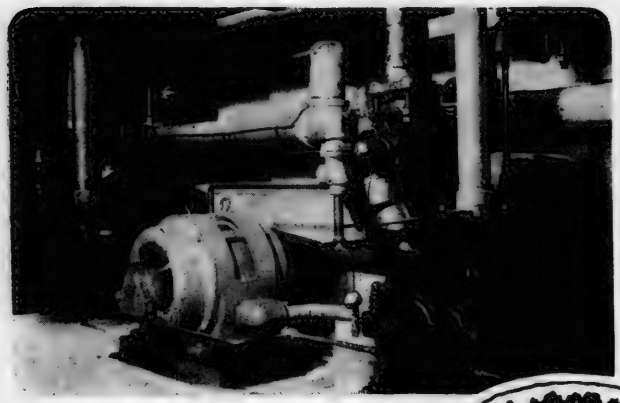
TITLE.....

COMPANY.....

ADDRESS.....



Two Frick 6-Cyl. "ECLIPSE" Compressors are the Heart of Air Conditioning System of Club at Right

More Than 300 People Enjoy Cool, Fresh, Clean, Dehumidified Air in This Club Banquet Room

TRADE FRICK MARK®

Air Conditioning and Refrigeration

Engineered To Suit Every Need

Small business operators; industrialists; hotel, apartment and tourist court men; theater owners; club managers; city, state and government officials; engineers, architects and contractors—they all specify Frick air conditioning and refrigeration when they want the finest, most dependable and most economical cooling system.

When you purchase a Frick installation you get not only superior equipment manufactured to the highest standards, but also the services of highly trained engineers, who design the system specifically to meet your cooling requirements.

Write today for catalogs and quotations.

DEPENDABLE REFRIGERATION SINCE 1882

FRICK CO.

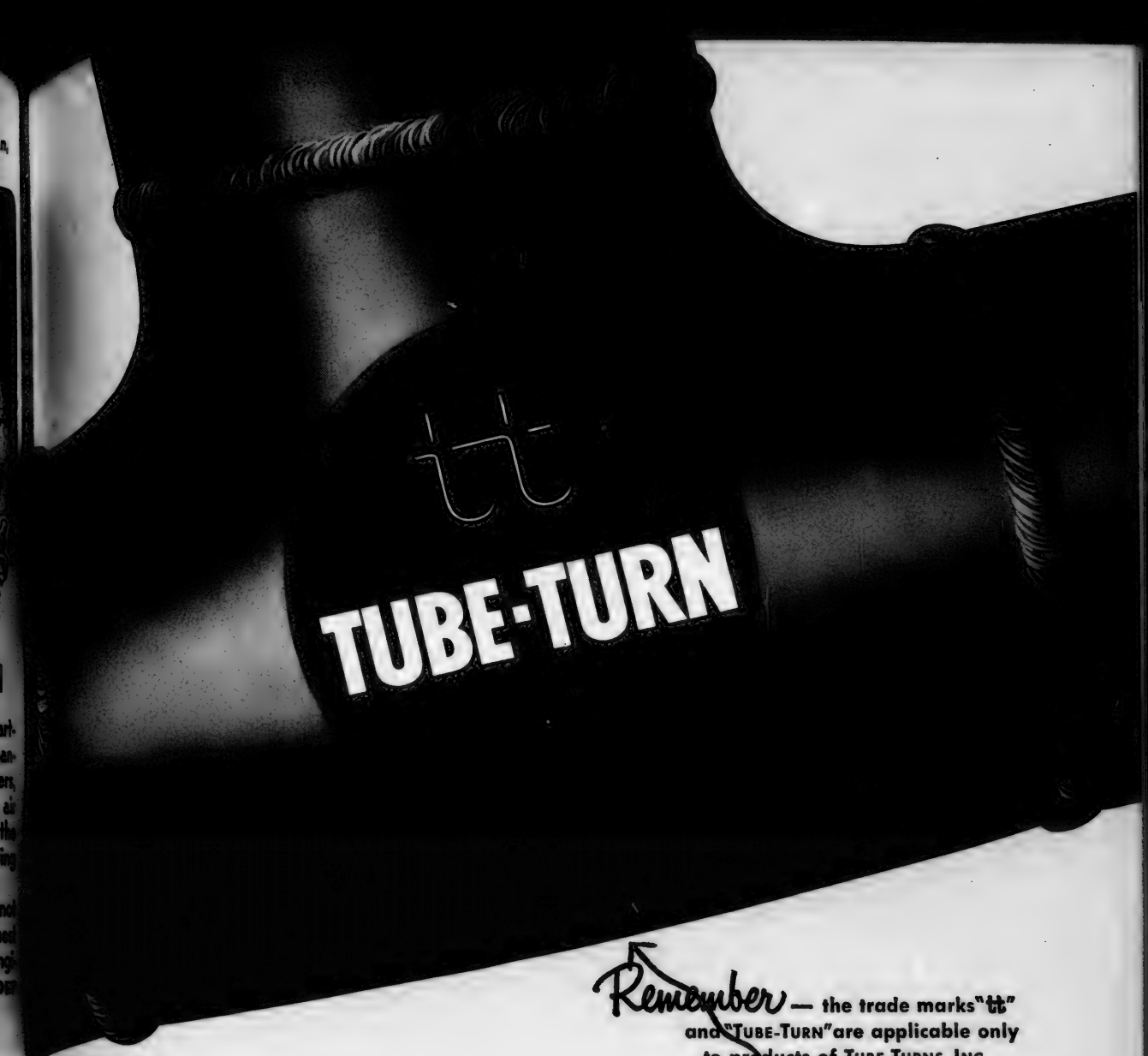
WAYNESBORO, PENNA. U.S.A.

Also Builders of Power Farming and Sawmill Machinery

Frick Unit Air Conditioners are Manufactured in 3, 5, and 7½ Horsepower Sizes—Give More Cooling Per Dollar

Shoe Stores, Drug Stores, Supermarkets, Shopping Centers, Department Stores Can All Increase Sales With Frick Year 'Round Air Conditioning

When the Owner of This Tourist Court Installed Air Conditioning, He Chose Frick—a Leader in the Field for Over Fifty Years



Remember — the trade marks "tt" and "TUBE-TURN" are applicable only to products of TUBE TURNS, INC.

Engineered FOR ENDURANCE

THIS TUBE-TURN WELDING TEE is drawn from seamless tubing to a barrel shape—the form every tee wants to assume under pressure. This design, plus the generous crotch radius and thickness, assure exceptional strength and endurance. In tests of representative fittings, bursting pressures have averaged over 25% higher than required by applicable standards.

This extra quality at no extra cost is typical of all TUBE-TURN Welding Fittings and Flanges. For satisfying service, and to fill all your requirements from one reliable source, get in touch with your nearby TUBE TURNS' Distributor. You'll find one in every principal city.

The Leading Manufacturer of Welding Fittings and Flanges

TUBE TURNS, INC. LOUISVILLE 1, KENTUCKY

DISTRICT OFFICES: New York • Philadelphia • Pittsburgh • Cleveland • Chicago • Denver • Los Angeles • San Francisco
Seattle • Atlanta • Tulsa • Houston • Dallas • Midland, Texas

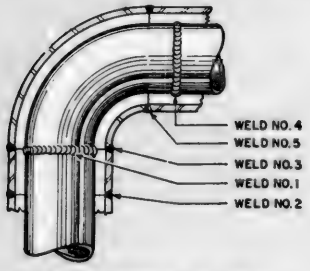
Subsidiaries: TUBE TURNS OF CANADA LIMITED, CHATHAM, ONTARIO • PENNSYLVANIA FORGE CORPORATION, PHILADELPHIA, PA.

TUBE TURNS' ENGINEERING SERVICE

develops new method of fabricating jacketed fittings

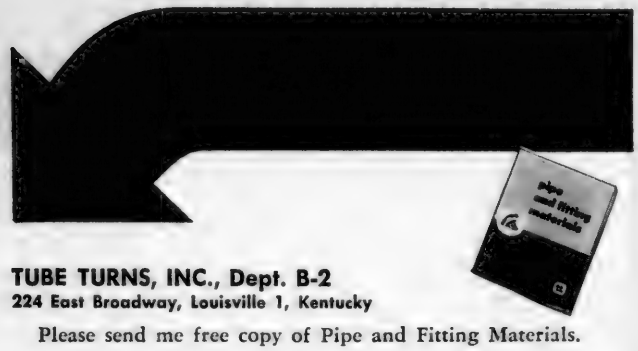
FABRICATION TIME AND COST can be reduced with this method of using welding fittings for directional changes in jacketed piping systems. The jacketed fitting combination consists of long and short radius TUBE-TURN Welding Elbows, with center-line radii closely matching. A tangent on one end of the inside elbow (see cut) extends beyond the corresponding end of the outside elbow. On the other end a short length of pipe is attached to simplify installation.

The method eliminates the need for steam and coolant jumpers, and also eliminates flanged joints, except where disassembly must be provided for. Insulation can be readily applied. Maintenance costs are sharply reduced, as all joints are permanently leakproof. The assembly provides optimum flow conditions, and minimized thermal problems.



Welding sequence for elbow of jacketed system.

This improved technique is another contribution to piping technology by TUBE TURNS' Engineering Service Division—always ready to help you with special piping problems.



TUBE TURNS, INC., Dept. B-2
224 East Broadway, Louisville 1, Kentucky

Please send me free copy of Pipe and Fitting Materials.

Company Name _____

Company Address _____

City _____ *Zone* _____ *State* _____

Your Name _____

Position _____

These water, steam, and air lines, using TUBE-TURN Welding Fittings to make directional changes, provide permanently leakproof service. Note compactness of layout, and how neatly insulation is applied.

SERVICE is the middle name of your nearby TUBE TURNS' Distributor. He can help you fill all your requirements from one reliable source. TUBE TURNS, INC. offers the world's broadest line of welding fittings and flanges, in a wide range of types, sizes, and more than 40 different alloys.

DISTRICT OFFICES

New York	Midland
Philadelphia	Tulsa
Pittsburgh	San Francisco
Cleveland	Los Angeles
Chicago	Seattle
Houston	Atlanta
Dallas	Denver

"tt" and "TUBE-TURN" Reg. U.S.

TUBE TURNS, INC
LOUISVILLE 1, KENTUCKY

ALLIS-CHALMERS

Air Conditioning PUMPS

3 Ways to Save

SAVE ENGINEERING TIME

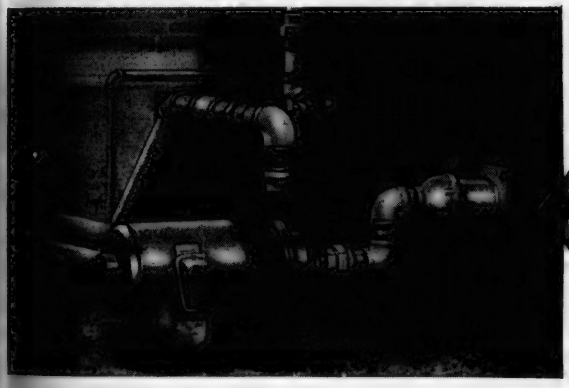
1

Allis-Chalmers representative will sit down with you in the planning stage and help you design the best possible air conditioning pump set-up at the lowest cost. A-C field engineers will save you much costly engineering work and *guarantee* the complete pump and motor unit.

SAVE—NO EXTRA PARTS TO BUY

2

Designed as a complete, compact unit, Allis-Chalmers close-coupled pumps don't require extras — such as couplings, bases or shims. The pumps come as units ready to hook up and run!



SAVE ON INSTALLATION TIME

3

Bolt it down, hook up the line and piping, and your Allis-Chalmers pump is ready to go. There's no alignment problem. Correct installation is a big factor in pump performance and the A-C engineer will advise you at this point.

For more information about Allis-Chalmers air conditioning pumps, write for bulletins 52B6140, 52B7529, 52B6083 or 52B6975.

ALLIS-CHALMERS, Milwaukee 1, Wisconsin

FHP PACKAGE PUMP

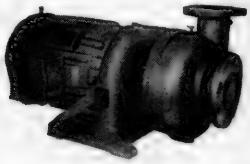
Standard with mechanical seal. Widely used and accepted for air conditioning and refrigeration.

Bulletin 52B7529

***ELECTRIFUGAL* PUMP**

A close-coupled pump with either conventional packing or mechanical seal.

Bulletin 52B6140



SUPPORTING ADAPTER PUMP

Flange motor and pump on sturdy supporting adapter. With conventional packing or mechanical seal.

Bulletin 52B6083

VERTICAL MOUNTED PUMP

Mechanical seal or sealless units with choice of submerged or sidewall mounting.

Bulletin 52B6975

Electrifugal is an Allis-Chalmers trademark.

ALLIS-CHALMERS

A-C ALLIS-CHALMERS

A-4210

HERE'S DUNHAM'S NEW

you save time and trouble

1. BEFORE YOU EVER GET TO THE JOB

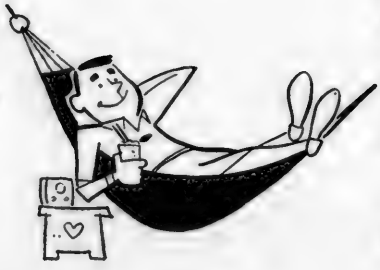
You can figure *any* hot water job faster . . . with less book work . . . when you depend on Dunham. One easy-to-use catalog puts the *industry's newest and most complete line* of hot water equipment right in your hands.

You save paper work, too, since one order to Dunham covers everything . . . not only circulators, valves, fittings, specialties and controls, but *all radiation* as well.

2. WHILE YOU'RE ON THE JOB

Since Dunham gives you everything you need in "one package" there's no need to hold up waiting for one "missing link." When you deal with Dunham, you get the *whole ball of wax at one time.*

Exclusive design improvements cut down installation time, too. Dunham's Balancing Fittings, for example, have a unique V-type seat that greatly simplifies balancing of the entire system. And on radiant heating jobs, Dunham's Distributor Heads cut installation time substantially.



3. AFTER YOU GET OFF THE JOB

You can relax when the job is in, knowing that you won't be bothered with "call backs." Dunham's 50 years in the heating business are your guarantee that from beginning to end your job is protected by equipment of the highest quality.

And when you make it a complete Dunham job, you put full responsibility for finished performance squarely up to *one manufacturer.*

CLIP THIS COUPON

DUNHAM HEATING EQUIPMENT

RADIATION • UNIT HEATERS • PUMPS • SPECIALTIES

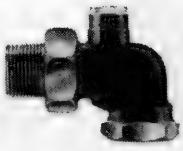
C. A. DUNHAM COMPANY • CHICAGO

COMPLETE HOT WATER LINE

all this...and radiation too!

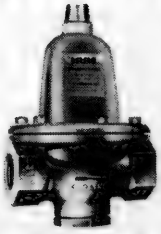
Dunham Circulators. Single spring motor-pump coupling eliminates troublesome service requirements. Field replaceable carbon rotary seals. Extra-large oil reservoir. Only well-known motors used. Two-bolt flange simplifies installation.

Dunham Circulator Valves. Exclusive extra-large water flow area reduces friction and pump load. Valve fully opens or closes with ¼ handle turn. Valves are self-cleaning.



Dunham Balancing Elbows and Fittings. Free water flow area larger than other balancing fittings; reduce friction and pump load. *Sloping valve seat* provides V-shaped opening for *more accurate balancing* than usual vertical seat types.

Dunham Pressure Relief Valves. Diaphragm type. Spring chamber sealed against discharge water. No guides on discharge side to stick or jam. Factory set at 30 lb. pressure.

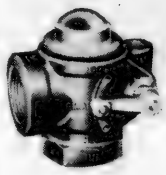


Dunham Pressure Reducing Valves. Built-in strainer; extra-large diaphragm. Special composition disc prevents chattering. Factory set at 12 lb. Adjustable. Combination relief and reducing valve available.

Dunham Expansion Type Air Vent. Cannot get out of order! Automatic venting. No adjustments needed. Can be manually shut off. *Not necessary to drain system to replace disc.* Maximum working pressure: 50 p.s.i.

Dunham Float Type Air Vent. Built-in siphon prevents "spitting," eliminates need for drain tube. Can be completely disassembled easily and quickly. Maximum working pressure: 35 p.s.i.

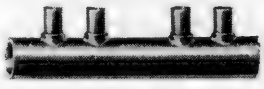
Dunham Flow Divertor Fittings. Assure proper hot water flow through all radiation units regardless of location. Only one fitting normally needed for each unit of radiation whether above or below main. All brass; thread or sweat connections.



Dunham Flow Control Valves. Completely automatic. No adjustment needed for winter-summer operation. Easy to clean without breaking pipe connections or removing valve mechanism.

Dunham Air Separator. Performs dual function: passes air from system to expansion tank and prevents re-entry into system; discharges remaining excess air to atmosphere. Heavy one-piece construction.

Dunham Vari-Flow Controls. Fully automatic indoor-outdoor temperature control for all types of hot water heating systems. Balances heat output with heat demand created by outdoor weather. Eliminates indoor thermostat.



Dunham Distributor Heads. For radiant hot water. 1¼" trunks with interchangeable ⅜" or ½" branches. Shipped in 5'3" lengths, each having 14 pairs of connections. Simple to cut on the job.

OMPLETE INFORMATION

C. A. DUNHAM COMPANY
Dept. HV-2, 400 W. Madison St.
Chicago 6, Illinois

Please send literature on your complete hot water line.

Name_____

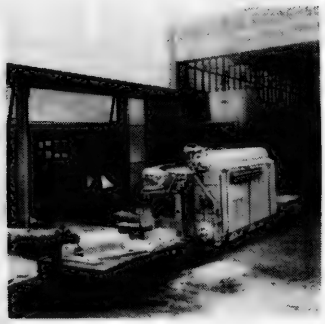
Firm_____

Address_____

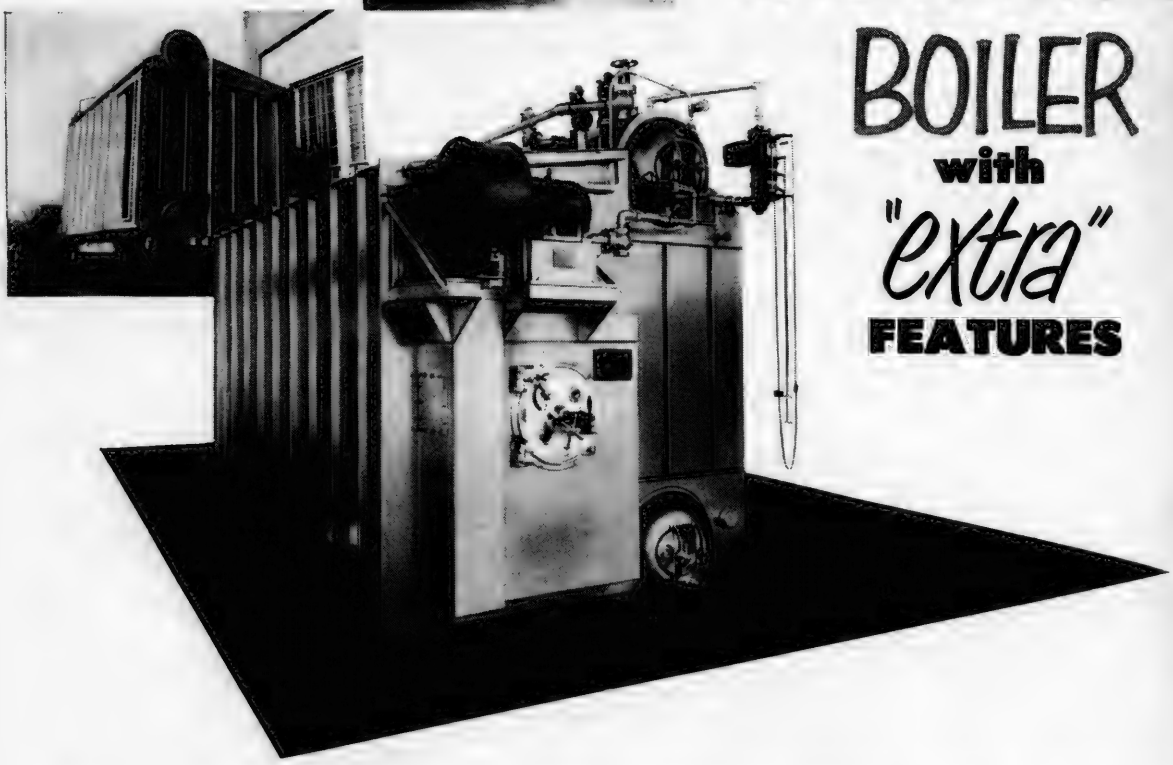
City_____ Zone____ State_____

UALITY FIRST FOR FIFTY-ONE YEARS

ORONTO • LONDON



MEET THE VP the PACKAGE BOILER with "extra" FEATURES



Most of the water-tube "package" boilers available today look very much alike. As a matter of fact, in some respects they are alike.

The prospective purchaser's job is to discover which of the several package boilers now available offers a combination of features and advantages that adds up to the "best buy".

Consider, then, the fact that the C-E Package Boiler, Type VP, has *all* the design features offered by any of its contemporaries *plus* the important extra features described at the right.

VP Boilers are available in capacities from 4,000 to 30,000 lb of steam per hr; pressures to 250 psi. Send for Bulletin VP-203.

FULLY WATER-COOLED FURNACE — Even the front or "burner" wall is protected, except in three smallest sizes. Has higher ratio of furnace-wall cooling to furnace volume than any boiler of its size and type. Assures rapid and efficient heat absorption, lower gas temperatures entering convection bank, reduced tendency to slag formation. Minimizes furnace maintenance.

LARGER LOWER DRUM — The large lower drum, 30″ in diameter, permits simple, symmetrical tube arrangement; provides easy access when necessary for washing down or for inspection; greater water storage capacity facilitates handling fluctuating loads.

CENTRIFUGAL FAN — This type of fan is more efficient, operates at lower speed and is quiet in operation. The average noise level is less than half that of typical high-speed blowers used on most boilers of this type. Low noise level is particularly advantageous in confined space and in such installations as hospitals.

SIMPLE BAFFLE ARRANGEMENT — Minimum changes in direction (no baffle at all in convection bank in larger size units). Gives lower draft loss. Simplifies soot blowing. Cross-flow of gas with elimination of dead pockets gives maximum heat pick-up. Water-cooled baffle in intermediate sizes insures minimum maintenance.

B-4427

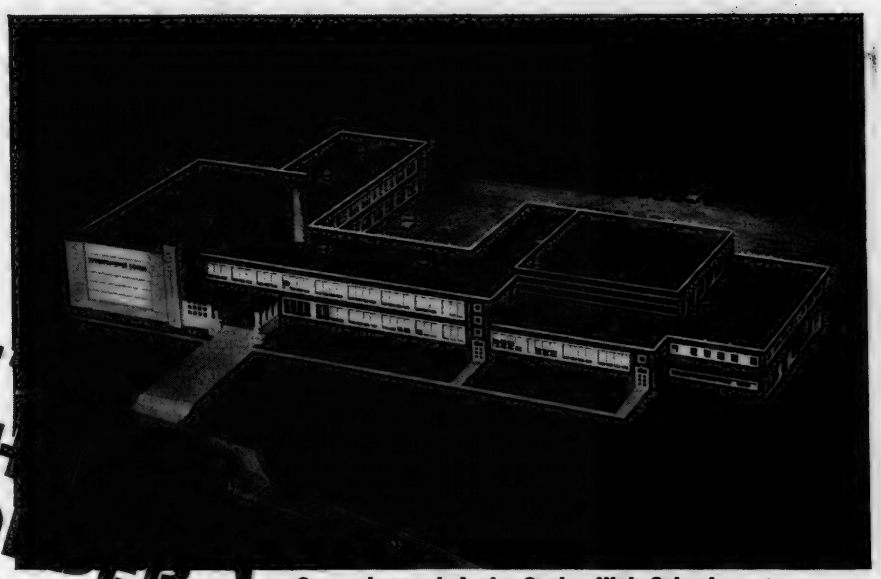
COMBUSTION ENGINEERING, INC.

Combustion Engineering Building • 200 Madison Avenue, New York 16, N. Y.

ALL TYPES OF STEAM GENERATING, FUEL BURNING AND RELATED EQUIPMENT

The most convincing stamp of user satisfaction

ANOTH
REPEAT O
FOR SARCO



Susquehannock Junior-Senior High School Southern York County, Pa. *Architect:* Buchart Engineering Corp. *Engineers:* W. K. Hood & Associates. *Heating Contractors:* J. L. Thomas. *Plumbing Contractors:* C. C. Kottcamp & Son.

21 times in two years

Buchart Engineering Corporation Specifies Sarco Heating Specialties for School Projects

PLAIN TALK! Here's what the Buchart Engineering Corp., York, Pa., School Designers, has to say about the dependability of Sarco Heating Specialties:

"...all our school projects equipped with Sarco traps, temperature regulators, water blenders and heating specialties have had satisfactory, dependable service throughout the years."

Sound reason why Sarco products were specified and installed in 21 schools designed by the firm during the last two years.

This record of confidence is convincing testimony to the dependability of Sarco Heating Specialties.

Why not specify Sarco on *your* next project and be assured of the same dependable performance.

Full information on all Sarco products is available on request. SARCO COMPANY, INC., Empire State Building, New York 1, N. Y. Representatives in principal cities.

SARCO

Sarco quality assures satisfaction

HERE ARE THE 21 BUCHART-DESIGNED PENNSYLVANIA SCHOOLS RELYING ON SARCO HEATING SPECIALTIES

- Kennard-Dale Junior-Senior High School
- Susquehannock Junior-Senior High School
- York Township Elementary School
- Red Lion High School
- Spring Grove Elementary School
- Dover Joint Elementary School
- Southampton Township Elementary School
- Quarryville Boro Elementary School
- Springettsbury Township Elementary School
- Spring Grove Joint High School
- Jefferson Elementary School
- McConnellsburg-Ayr-Todd Elementary School
- Union-East Buffalo Elementary School
- Pequea Township Elementary School
- Mt. Rose Junior-Senior High School
- Kennard-Dale Junior-Senior High School Addition
- Stewartstown Elementary School Addition
- Windsor Township Elementary School
- Jackson Township Elementary School
- New Salem Elementary Center
- Springettsbury Independent Elementary School Addition

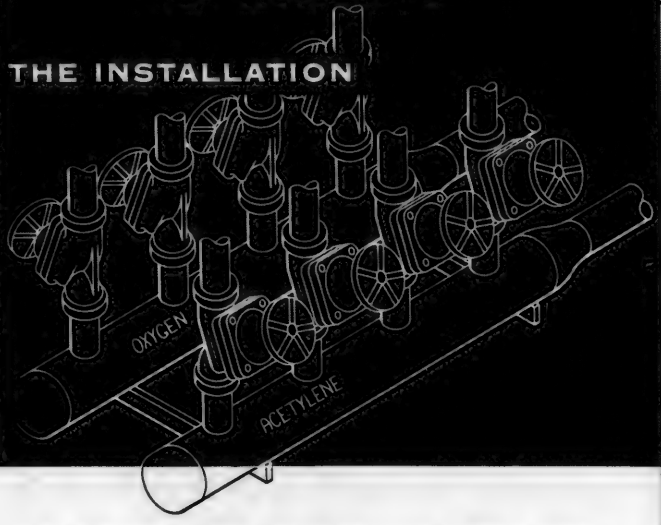
STEAM TRAPS • TEMPERATURE CONTROLLERS • HEATING SPECIALTIES

Radiator Valves • Traps | Strainers | Float-Thermostatic Traps | Camlift Bucket Steam Traps | Thermostatic Traps | Water Blenders | Air Eliminators | Dial Thermometers | Self-Operated Temp. Reg.

This Valve Stops Hidden Losses

...in Welding Gas Systems, for instance

THE INSTALLATION



In a prominent New Orleans shipyard, with Crane Diaphragm valves listed as "standard operating procedure" for complete oxygen-acetylene system. Shown is typical installation on portable manifold.

VALVE SERVICE RATINGS

SUITABILITY:
100% effective – no leakage

FEATURES:
No seating stress on diaphragm

MAINTENANCE COST:
Zero

SERVICE LIFE:
Installed 2 yrs. – long life indicated

OPERATING RESULT:
Big savings on welding gas costs

AVAILABILITY:
Crane Catalog item – No. 1652

THE CASE HISTORY

Costly loss of welding gases was traced to the conventional packed valves formerly used on the system. Leakage through the stuffing persisted despite frequent, regular servicing of stem packing on the valves. This high maintenance cost added to the yard's loss.

The remedy was found in Crane No. 1652 packless Diaphragm Valves, Underwriters approved for the service. These valves stopped the leakage, and not one Crane valve has needed attention since installed more than 2 years ago. Despite continued expansion, the yard's costs for welding gas have been sharply reduced.

THE VALVE

The modern packless valve with Neoprene diaphragm that serves only to seal the bonnet. Its independent disc saves diaphragm wear, provides positive seating on fluid, even should the diaphragm fail. Choose from a wide range of body and trim materials for all kinds of corrosive and ordinary services. Sizes ½ to 6 in.; screwed or flanged ends. See your Crane Catalog, or your Crane Representative.

THE BETTER QUALITY...BIGGER VALUE LINE...IN BRASS, STEEL, IRON

CRANE VALVES

CRANE CO., *General Offices:* 836 S. Michigan Ave., Chicago 5, Illinois
Branches and Wholesalers Serving All Industrial Areas

VALVES • FITTINGS • PIPE • PLUMBING • HEATING

for intermediate capacity cooling!

MARLEY Double-Flow Aquatower*

There's only *one* cooling tower in the intermediate-capacity range that delivers *big-tower* performance! It's Marley's Double-Flow Aquatower, the first completely new cooling concept in recent years for jobs requiring 50 tons or more of refrigeration.

A glance at the photo above explains the immediate and enthusiastic reception of this new tower among professional refrigeration and air conditioning men. Note particularly the exclusive Marley industrial tower features —open, gravity-flow distribution . . . one fan pulling air uniformly through two open sides . . . all vital tower parts within full view and completely accessible. Still another unusual feature is appearance—the low silhouette that complements any type building.

Double-Flow Aquatowers, constructed of redwood with asbestos cement board casing, are available in single or multi-cell units. Write today for Bulletin DFA, or see your Marley representative in any of 50 cities for complete information.

*Registered Trademark

MARLEY

The Marley Company

Kansas City, Missouri

MICROLITE fits any shape

The fact that ducts come in assorted shapes and sizes is what endears Microlite glass fiber insulating wool to the guys on the job. Microlite is so soft and compressible and lightweight it can be wrapped easily around any shape or system—in the hardest-to-get-to locations. Clings like the proverbial vine. Is so tough it doesn't have to be babied. Doesn't itch. Cuts easily with knife or scissors. Can be quickly fastened by adhesion or stapling. And on top of all that, inch for inch Microlite is one of the most effective of all insulating materials from sub-zero to 400° F. For folder and samples write to Glass Fibers Inc., 1810 Madison Avenue, Toledo 2, Ohio.

MICROLITE *is an excellent absorber of sound* • **MICROLITE** *is inorganic, resists fire and moisture*
MICROLITE *is fungus-and-bacteria proof* • **MICROLITE** *is shipped in space-saving rolls compressed 4-to-1*

VITRON Glass Textile Yarns • Rovings • Micro-Fibers
DURAMAT Vapor Barriers • **BLUE FLAG** Pipe Wrap
MICROLITE Thermal and Acoustical Insulation
VIBRAGLASS Mounting and Packaging Materials
COUSTIC-AIRE and **THERMO-JET** Aircraft Insulations

...ASS FIBERS INC.

Makers of glass fibers by the ELECTRONIC–EXTRUSION process ... developed, patented and used exclusively by Glass Fibers Inc.

In The "Buffalo" Fan Balancing Room

THE IMPORTANCE OF MAINTAINING BALANCE OF FAN WHEEL

PROBLEM:

excessive vibration in exhaust fan delivering dust-laden air to cyclone. Fan operated smoothly a number of years, but gradually developed vibration and finally damaged the bearings.

SOLUTION:

Fan Wheel found to be far out of balance due to uneven buildup of slightly moist dust particles on blades. Fan rotor had never been cleaned, and had condition been permitted to continue, further bearing troubles and a sprung shaft might have resulted. "Buffalo" representative advised owner to clean rotor every six months, then check wheel balance. Fan has since operated smoothly, with no further bearing trouble, and at greatly reduced noise level. NOTE: all "Buffalo" fan rotors are balanced both statically and dynamically on precision balancing machines at the factory. Regular periodic cleaning and repainting followed by a balance check will assure added years of smooth, efficient performance.

This is one of thousands of problem-solution case histories accumulated in "Buffalo" files during our 77 years of building air handling equipment and solving air problems for industry. Call your nearest Buffalo Engineering Sales Representative — get the benefit of his factory trained "know-how" and experience to help you solve your air problems.

"Buffalo"

FORGE COMPANY

BUFFALO 4, N.Y.

...ishers of "Fan Engineering" Handbook

Canad... Co., Ltd., Kitchener, Ont. Sales Representatives in all Principal Cities

... AIR TEMPERING INDUCED DRAFT EXHAUSTING FORCED DRAFT COOLING HEATING PRESSURE BLOWING

Prepare Now for the Profitable Jobs...

with the expanded line of

Curtis

AIR CONDITIONING AND REFRIGERATION EQUIPMENT

This complete line of CURTIS equipment assures highest possible efficiency, dependability and quality... at a price that is profitable for you.

Not only will you be equipped to handle any installation but you will be selling equipment that is accepted the world over, and that is proven by 100 years of successful manufacturing experience.

To help you sell more CURTIS Air Conditioning and Refrigeration equipment, it is nationally advertised in *Saturday Evening Post, Time* and *Newsweek,* plus many other national magazines.

For immediate information on how to make your operation more profitable, mail this coupon for details of how you may secure a direct factory franchise:

CM-773

CURTIS REFRIGERATING MACHINE DIVISION
of Curtis Manufacturing Company
1999 Kienlen Avenue, St. Louis 20, Missouri
I am interested in direct factory franchise. Send complete details.

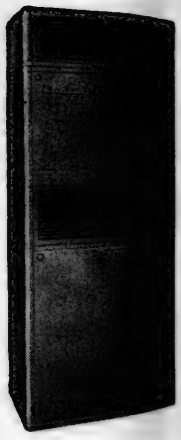
Company Name.....

Street.....

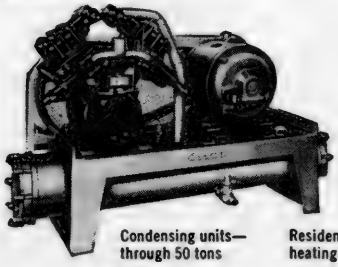
City.....Zone....State.....

Signed.....

Evaporative Condensers, Cooling Towers and Air Handling units to match

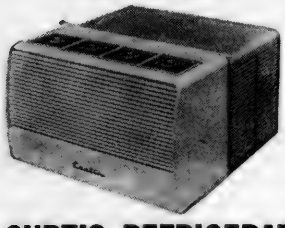


Packaged Air Conditioners—2, 3, 5, 7½, 10 and 15 tons



Condensing units—through 50 tons

Residential cooling and heating units



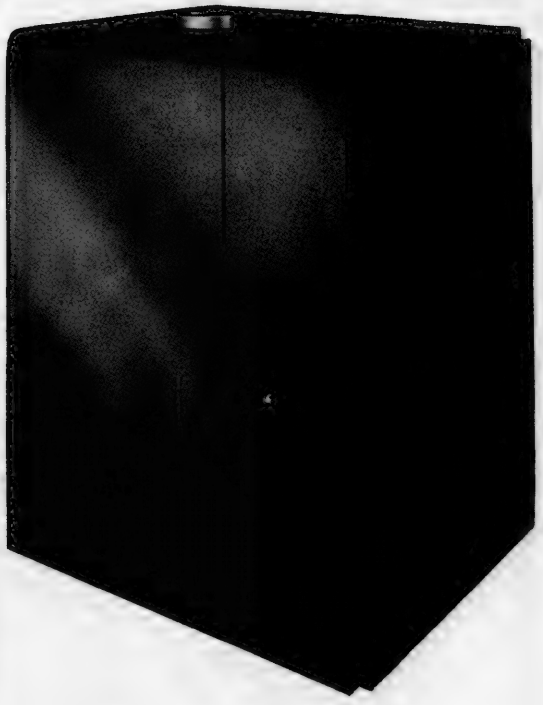
New 1954 Curtis Room Air Conditioner in three popular sizes.

CURTIS REFRIGERATING MACHINE DIVISION
1999 Kienlen Ave. — St. Louis 20, Mo.

All along the line...

H.B. Smith Gas Boiler

has Everything



FOR THE ARCHITECT AND ENGINEER

The compact size and high efficiency of the H. B. Smith "Century" permits freedom of design and ease of installation. The boiler is equally at home in rumpus room or boiler room since it is attractive in appearance and clean in operation.

FOR THE CONTRACTOR

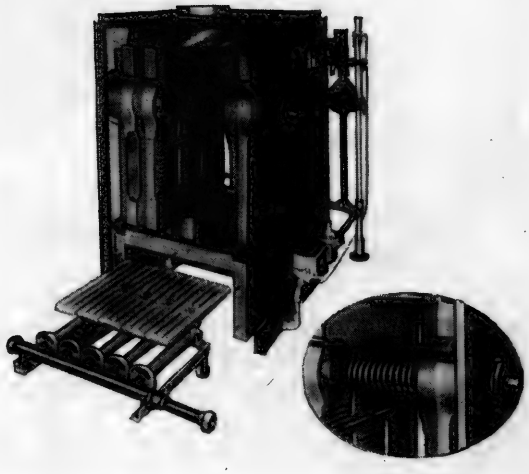
The "Century" is easily assembled by two men in less than two hours. All piping and control connections may be made on *either* the left or right side. All gas controls and safety devices are of the latest A.G.A. listed type, conveniently located.

FOR THE GAS COMPANY

The company benefits because here is a gas boiler that is a credit to its fuel (natural, manufactured or mixed). It is far and away the easiest gas boiler to service. Just disconnect one union and the entire burner assembly rolls out on casters. *All* internal surfaces may be cleaned easily without disturbing the draft hood or smoke pipe.

FOR THE OWNER

As they should, the majority of this boiler's many advantages accrue to the user. He enjoys the benefits of moderate initial cost, carefree heat, abundant hot water, and long-life performance which makes his heating *cost per year* an advantageous investment. He will be proud to show his friends his H. B. Smith gas boiler — truly the gas boiler of the century.



Optional built-in tankless domestic hot water heater provides up to eight gallons per minute. Tank heaters also available.

H.B. Smith **CAST IRON BOILERS**

Established 1853

THE H. B. SMITH COMPANY, INC., WESTFIELD, MASSACHUSETTS

Wagner®
ELECTRIC MOTORS
...the choice of leaders in industry

Wagner Hermetic Motors

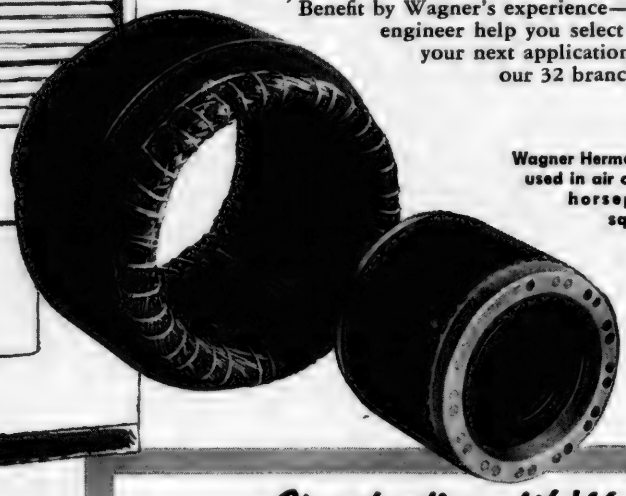
help insure your sealed units against motor failure

When your motor drives are to be hermetically sealed in compressor units, whether of the "accessible" type or in a completely sealed compressor housing, it's to your advantage to specify Wagner Hermetic Motors for use on your equipment. Here's why . . .

Hermetically sealed compressors demand motor parts that will operate with great dependability for years and years. They must insure the sealed unit against motor failure because your product gets the blame when the motor fails.

Wagner Hermetic Motors, like all Wagner motors, are known to give extremely long life with exceptionally little trouble. They are backed by more than sixty years of motor building experience. Every Wagner hermetic motor is precision-built and carefully tested.

Benefit by Wagner's experience—let a skilled Wagner engineer help you select the motor drive for your next application. Call the nearest of our 32 branch offices, or write us.



Wagner Hermetic Motor of the type used in air conditioners. This 7½ horsepower polyphase squirrel-cage motor is especially designed for use in sealed refrigeration units.

Hermetically sealed compressors for air conditioners and refrigerating equipment are rapidly gaining preference because of the great convenience they offer to users of the equipment—there is nothing to oil or adjust, no belts to fail.

Standardize with Wagner:

Wagner Motors are the choice of many leading equipment manufacturers for several basic reasons:
First, Wagner Motors, for over sixty years, have established unexcelled records for continuous, trouble-free performance.
Second, Wagner Motors are well known for their superior quality and their sturdy design and construction.
Third, the many types of motors and motor modifications in the standard Wagner line help the design engineer in his selection of the right motor for the job.

Wagner Electric Corporation
EST. 1891

WAGNER ELECTRIC CORPORATION
6463 PLYMOUTH AVE., ST. LOUIS 14, MO., U.S.A.

BRANCHES AND DISTRIBUTORS IN ALL PRINCIPAL CITIES

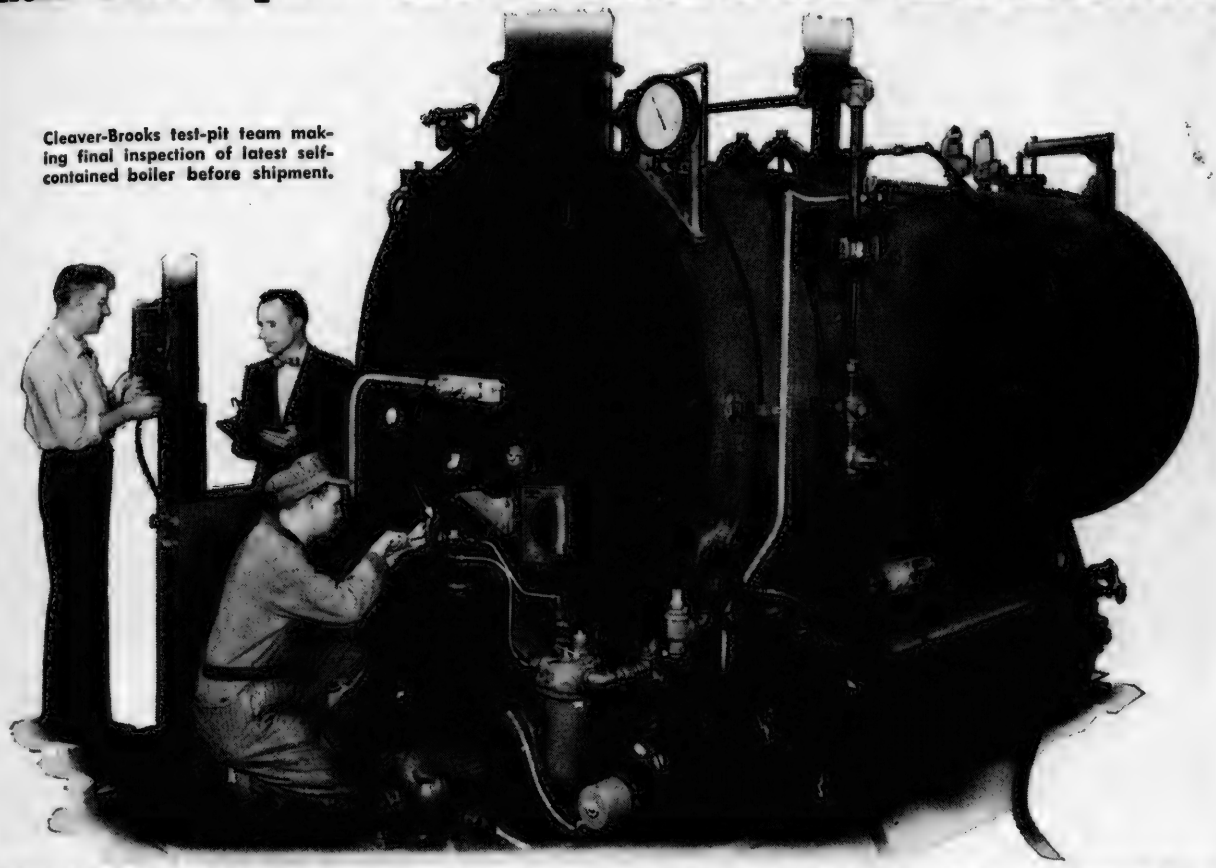
ELECTRIC MOTORS
TRANSFORMERS
INDUSTRIAL BRAKES
AUTOMOTIVE BRAKE SYSTEMS—AIR AND HYDRAULIC

M54-2

their counterpart

"Test-Pilots" have at Cleaver-Brooks

Cleaver-Brooks test-pit team making final inspection of latest self-contained boiler before shipment.



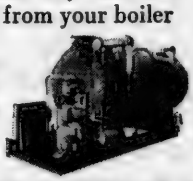
HIGH SCORES . . . on factory and on-job tests guarantee greatest return from boiler investment

When test pilots give the familiar "O.K." — that's the sign of proven performance. It's the same with boilers in the Cleaver-Brooks plant. Only after accurate, thorough inspection and testing under actual operating conditions do boilers get the final "O.K." from experienced test engineers. That's why you get guaranteed 80% efficiency from your Cleaver-Brooks boiler when firing with oil.

A record of this test is available to every buyer on request. In fact, you as a buyer, consultant, or contractor are invited to witness the actual test on your Cleaver-Brooks boiler before shipment.

And further, Cleaver-Brooks boilers are placed in operation at the job site by factory service engineers who check installation, train your operators and make complete and detailed field tests.

So, when you buy a boiler, insist on factory tests as well as field service tests by qualified engineers. There is no better way of insuring yourself of the very best value money can buy and the greatest return from your boiler investment. Look to Cleaver-Brooks, the leader in the "Packaged" Boiler field for two decades. Write today for latest Catalog AD-100.



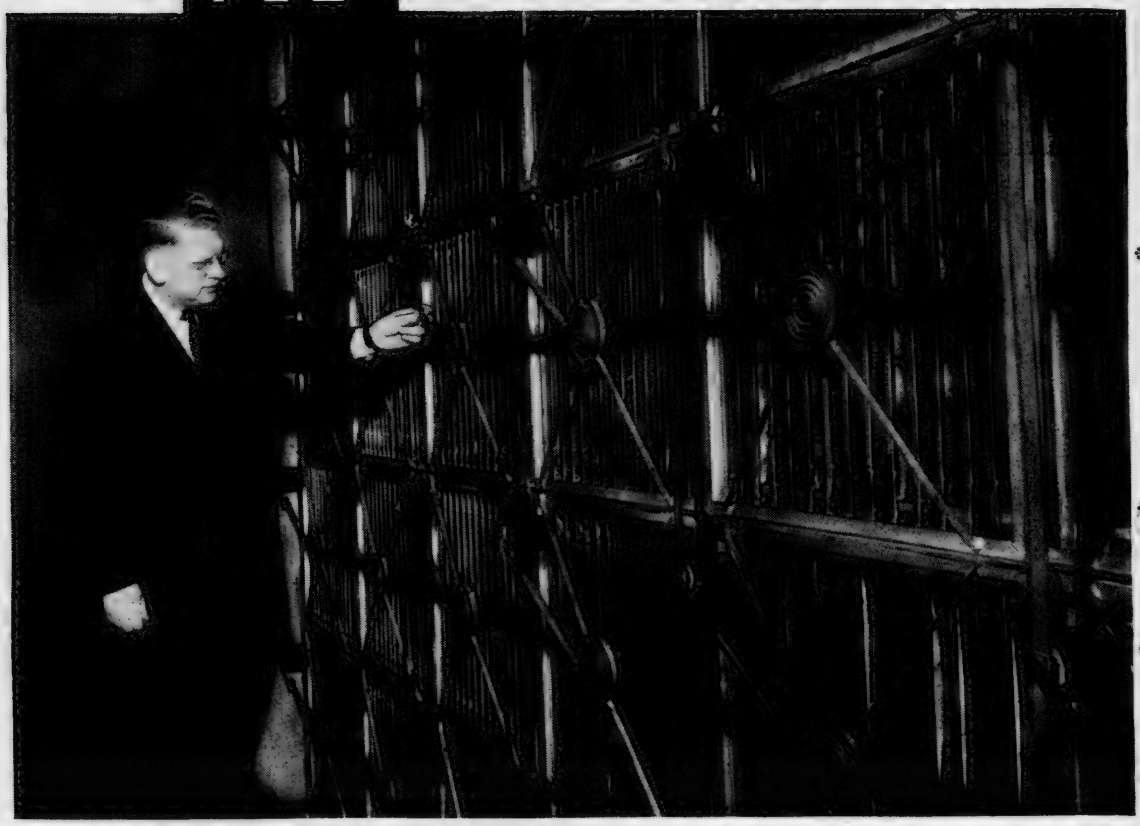
Available for oil, gas and combination oil/gas firing.

CLEAVER-BROOKS COMPANY
Dept. B, 314 E. Keefe Ave.
Milwaukee 12, Wisconsin, U.S.A.

Cleaver-Brooks
Originators of the Self-Contained Boiler

BOILERS — STEAM OR HOT WATER — FOR HEATING AND PROCESSING IN SIZES FROM 15 TO 500 HP, 15 TO 250 PSI

only AAF makes the complete line



AAF's ELECTRO-PL—an exclusive development of AAF engineering research, and the world's only dry-type electronic air filter! It offers these important advantages • Low initial cost • Easy installation • Simple economical maintenance • Safety in operation • Efficient air filtration even when there are power failures.

In the above photograph we show part of the ELECTRO-PL installation which provides a constant clean air volume of 95,000 cfm for the Bell Savings and Loan Association Building in Chicago, Illinois. Architects and Engineers: JOHNSON AND JOHNSON; *Mechanical Contractors:* ACORD VENTILATING COMPANY.

ELECTRO-MATIC

ELECTRO-CEL

* ELECTRO-PL

ELECTRO-MIST

* ELECTRO-KLEAN

* AUTO-AIRMAT

* AIRMAT PL-24

* DEEP-PAK

* DEEP BED

AA/W & HV UNITS

* DRIFILTER

MULTI-DUTY

RENU-GLAS

AMER-GLAS

Why does AAF make 7 dry-type* air filters?

The answer is simple, but *important* to all Engineers and Executives responsible for air cleaning applications. These seven different dry-type air filters were specially designed to meet the complex combination of factors facing the engineer in solving dust and air contamination problems.

AAF's seven types of dry filters offer the engineer maximum flexibility in combining the following factors to fit specific job requirements:

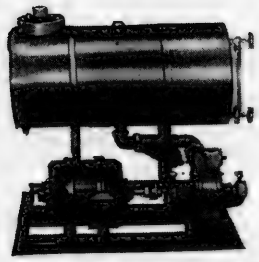
- Cleaning Efficiency
- Maintenance Methods
- Space Requirements
- Sizes and Air Volumes
- Practical and Realistic Range of Costs

Our nation-wide Sales and Engineering staff is at your disposal. Please write or wire . . . no obligation of course. Fully descriptive literature on all of these AAF filters is available on request.

American Air Filter
COMPANY, INC.
294 Central Avenue, Louisville 8, Kentucky
American Air Filter of Canada, Ltd., Montreal, P. Q.

Skidmore Pumps

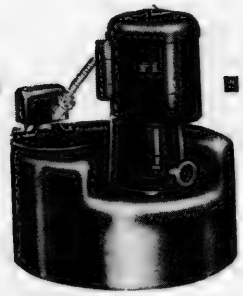
top performance



TYPE "TM" PUMP
Boilers to 250 hp—Pressures up to 150 lbs.

Place your confidence in a SKIDMORE PUMP

Your Skidmore Representative can offer you valuable suggestions in planning your installations. He knows the different pump problems and how to select the correct type best suited to your particular needs. Why not call or write your authorized Skidmore Representative or factory today!

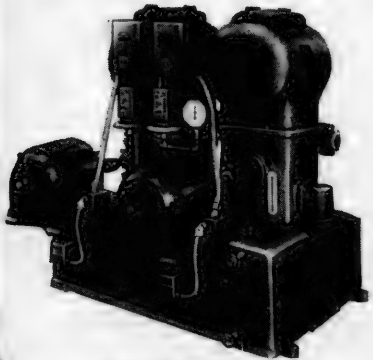


TYPE "CV" PUMP
Capacities 500 to 10,000 sq ft EDR
Pressures from 10 to 20 lbs.

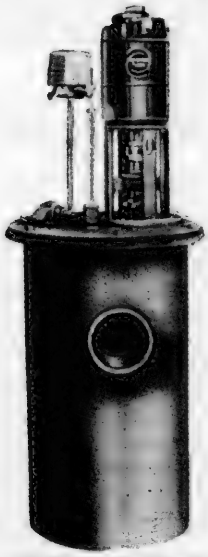
Write for bulletins

TYPE "TM" —*BULLETIN NO. 17*
TYPE "CV" —*BULLETIN NO. 21-A*
TYPE "UV" —*BULLETIN NO. 19-A*
TYPE "HS" —*BULLETIN NO 14-A*
VACUUM PUMP —*BULLETIN NO 9-B*

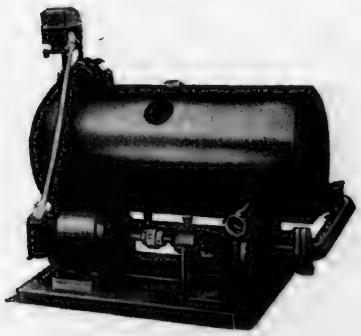
Pumps are available in both single and duplex units.



VACUUM PUMP
Capacities from 5,000 to 100,000 sq ft EDR



. TYPE "UV" PUMP .
Capacities 2,000 to 40,000 sq ft EDR. Discharge pressures from 10 to 75 lbs.

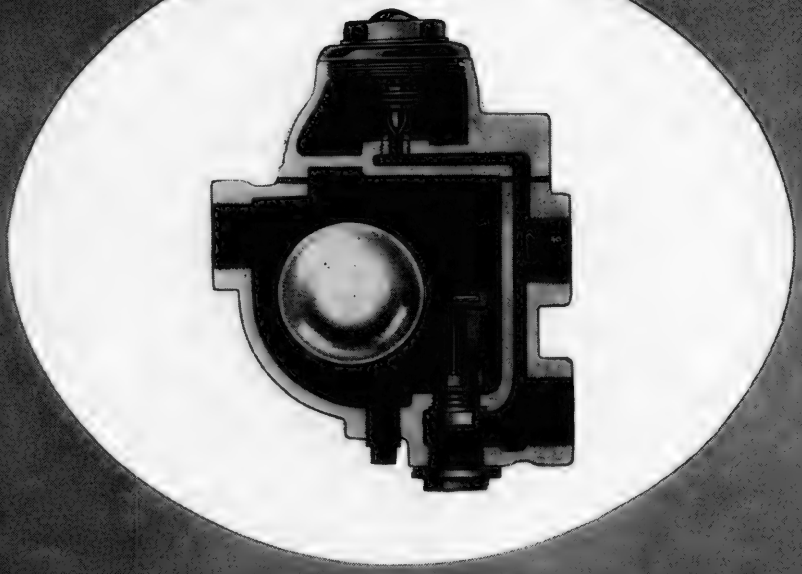


TYPE "HS" PUMP
Capacities from 1,000 to 65,000 sq ft EDR. Pressures from [illegible] 75 lbs.

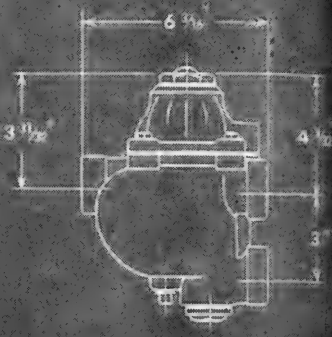
SKIDMORE CORPORATION ● ST. JOSEPH, MICHIGAN

MARSH No. 12

Float and Thermostatic Trap



Marsh No. 12, for 0-15 psi, and No. 512, for 15-125 psi, are available in either ¾" or 1" pipe size. Note two optional outlet openings.



. . . The most dependable trap you can use

There are many jobs that only a float *and* thermostatic trap can handle properly . . . and in the Marsh No. 12 you have the most respected F & T trap ever developed.

Here is a trap that counts its users in thousands. Repeat orders are the rule because men who know have discovered that no other trap can quite duplicate its absolutely dependable, trouble-free performance in removing all air and condensate from steam mains, branches, risers, unit heaters, coils, and similar applications.

Two precision-built assemblies accomplish this. All condensation is discharged by the float-operated valve located at the low point in the trap body. All air is vented through the by-pass by the action of the thermostatic diaphragm, but this is one of those Marsh diaphragms that closes the valve immediately in the presence of steam. In fact the accuracy of response is the attribute that distinguishes the Marsh thermostatic element. It gets the air out and keeps the steam *in!* Another big feature is the straight through design which eliminates troublesome excess piping.

No. 12 is your F & T trap for those low pressure applications — up to 15 psi W.S.P. but its identical-in-operation companion, No. 512, covers the working pressure range of 15 to 125 psi. There is a Marsh trap for every low or medium pressure application.

Write for catalog 76-H covering Marsh heating specialties

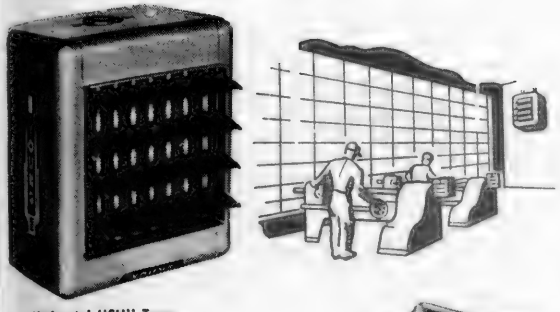
MARSH HEATING EQUIPMENT CO., *Sales Affiliate of Jas. P. Marsh Corporation*

Dept. U, Skokie, Illinois

Manufacturers of gauges, thermostatic regulating valves, Solenoid valves, heating specialties

MARSH *Heating Specialties* **SINCE 1865**

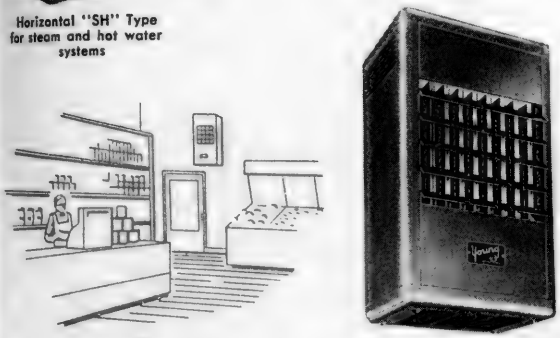
These Young Unit Heaters are Heating "Specialists"!



Horizontal "SH" Type for steam and hot water systems

FOR GENERAL PURPOSE REQUIREMENTS

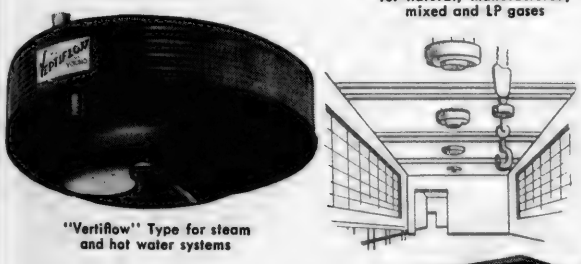
Here's an all-purpose unit for most general heating requirements . . . Young "SH" Type horizontal Unit Heater, available in fourteen models, for use with steam and hot water systems. Heavy-duty casings are made of braced and welded furniture steel with rounded corners, durable baked-on gray enamel finish, and individually adjustable louvers. Features include quiet, rubber-mounted motor, spring-suspended mechanically bonded tube-and-fin heating element, plus 15 other design advantages.



Horizontal Gas-Fired Type for natural, manufactured, mixed and LP gases

Young Gas-Fired Units, with horizontal delivery, are especially suited for installations not requiring a boiler. Available in eight physical sizes these units feature aluminized steel construction. Molten aluminum is permanently bonded to steel base metal in both combustion chambers and heat exchanger, to withstand the corrosive effects of gases and high temperatures. Approved by the AGA for use with either natural, manufactured, mixed and LP gases.

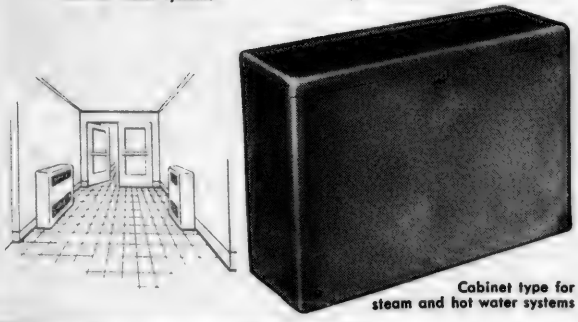
FOR DELIVERING HEAT FROM HIGH CEILINGS



"Vertiflow" Type for steam and hot water systems

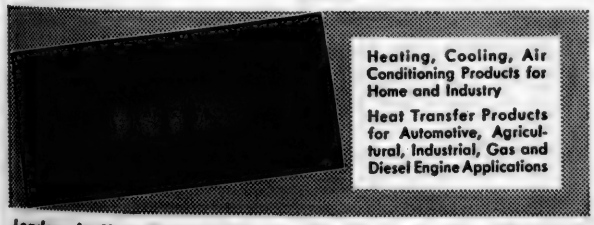
Where direct, downward distribution of heated air is desired . . . above craneways and other high-ceiling installations . . . Young "Vertiflow" Unit Heaters should be specified. Seven models, for use with steam and hot water, may be equipped with several types of adjustable diffusers and Anemostats for various heating patterns. Exclusive ventilating stack surrounds motor with cooler room air, prevents failure due to overheating. Features quiet operation, mechanically bonded tube-and-fin heating element, etc.

FOR WARMING COLD SPOTS WHERE APPEARANCE IS IMPORTANT



Cabinet type for steam and hot water systems

Lobbies, vestibules and similar installations require unit heater performance, plus an attractive appearance. For these Young offers Cabinet Units with three sizes in each of three cabinet styles for use with steam and hot water systems. With accessories, these units may be wall-hung, inverted wall-hung, ceiling mounted, free-standing, with ducts, inlet grilles, etc. Features quiet operating blower assembly with entire unit designed for ease of installation.



Heating, Cooling, Air Conditioning Products for Home and Industry

Heat Transfer Products for Automotive, Agricultural, Industrial, Gas and Diesel Engine Applications

Leaders in Heat Transfer Engineering for more than 25 years

For further information, including ratings, dimensions, construction features, etc., see your nearest Young Representative or write for free catalogs.

YOUNG RADIATOR COMPANY

Dept. 524-B • Racine, Wisconsin

Plants at Racine, Wisconsin and Mattoon, Illinois

Sales and Engineering Representatives in All Principal Cities

Points to look for when you select a Packaged Boiler:

1 Fiberglas insulation with metal jacket and metallic paint finish.

2 Lift lugs for convenient handling on job site.

3 Boiler shell made of flange quality steel. All joints electrically welded. High pressure shells X-rayed to insure flawless construction and long life.

4 Separator to assure dry steam supply (99%+).

5 Practical front-end construction provides open flow of combustion gases to stack. No refractories to maintain. Entire burner front hinged, providing easy access to fire tubes.

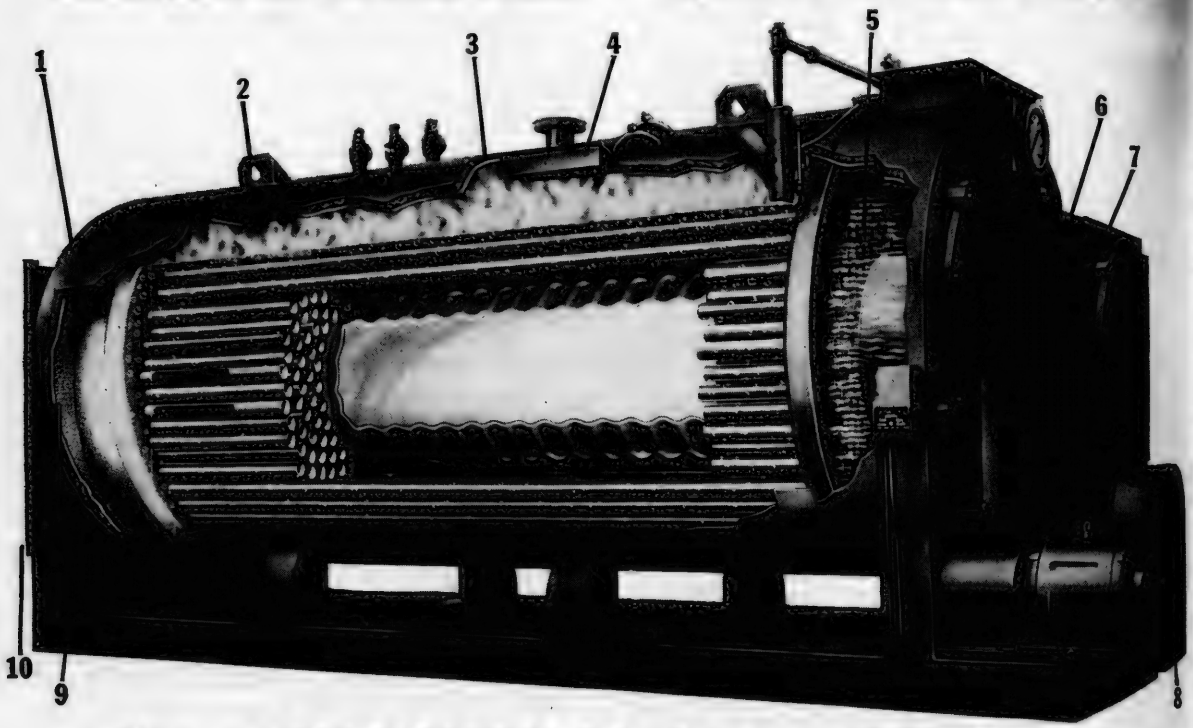
6 Burner and its vital parts—such as fuel nozzles, flame scanner and ignition assembly—fully enclosed in steel housing for safe operation.

7 Dual air-flow burner—for oil or gas fuels—precisely fitted to the boiler furnace. Burner specially designed to mix fuel and air for high combustion efficiency. Heat transferred directly to water surrounding the furnace.

8 Air for the burner passes through an inlet silencer to a forced draft fan. Air flow controlled by adjustable dampers.

9 Structural steel base distributes weight evenly on boiler room floor. No special foundation required.

10 Hinged rear door lined with insulating refractory. Door can be opened in a few minutes—affording access to furnace and all return tubes. No need to remove and replace refractory baffles or brick work. Note sturdy hinge construction which insures positive seating of door.



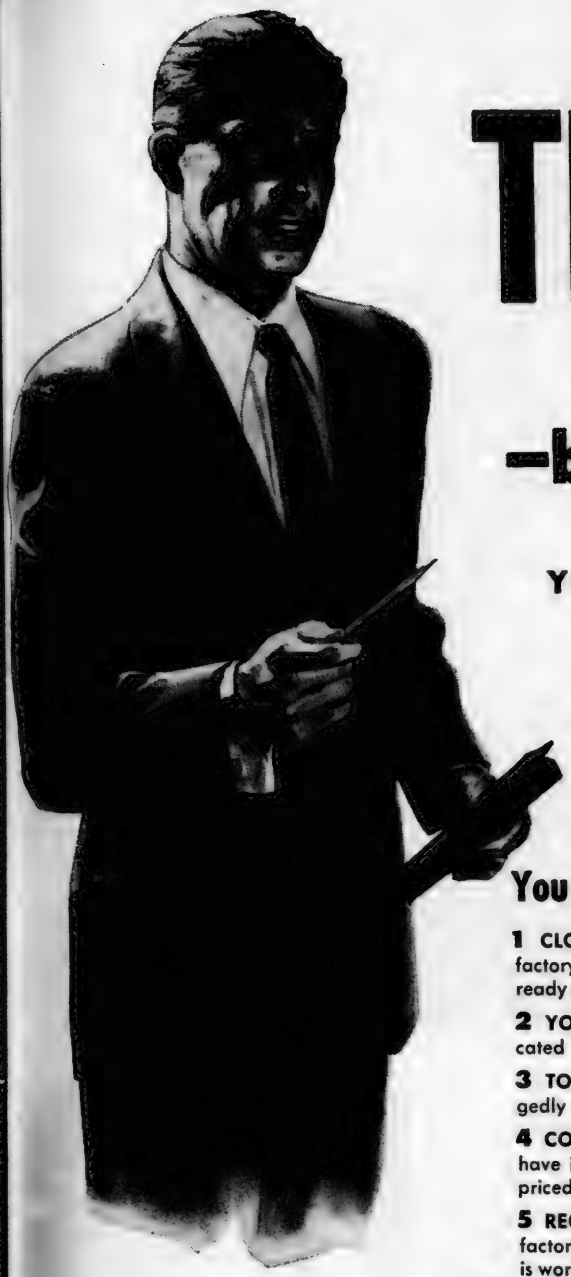
The CONTINENTAL Automatic Boiler

- Two-pass design—simple and practical. Range 20 to 500 hp.
- Factory-tested before shipment. Guaranteed 83% efficiency.
- Maximum radiant heat transfer from flame to water-cooled furnace walls.
- Even heat transfer—uniform flow of hot combustion gases through all return tubes.
- Free and rapid water circulation keeps all heating surfaces clean and improves transfer of heat to boiler water.
- High CO_2 and low stack temperature—guaranteed not to exceed 125°F. above saturated steam temperature at operating pressure.

CONTINENTAL BOILER DIVISION
BOILER ENGINEERING & SUPPLY COMPANY, INC.
1000 Manavon Street • Phoenixville, Pa.

40 YEARS OF BOILER MANUFACTURING EXPERIENCE

CONTINENTAL is sold, installed and serviced by competent distributors throughout the U.S.



THIS MAN

is on your Sales Force —but not on your Payroll

YOUR TYPHOON DISTRICT MANAGER

He's an estimator, a trouble-shooter, a fixer-upper... he's a technical adviser, a crack salesman, he's Johnny-on-the-spot. When the sale hangs in the balance you're mighty glad to have your Typhoon district manager around... you're mighty glad you signed up with Typhoon.

You profit 5 ways with a Typhoon Franchise

1 CLOSE FACTORY COOPERATION • You deal direct with the Typhoon factory. Every member of the organization—right on up to the president—is ready to pitch in and work with you personally.

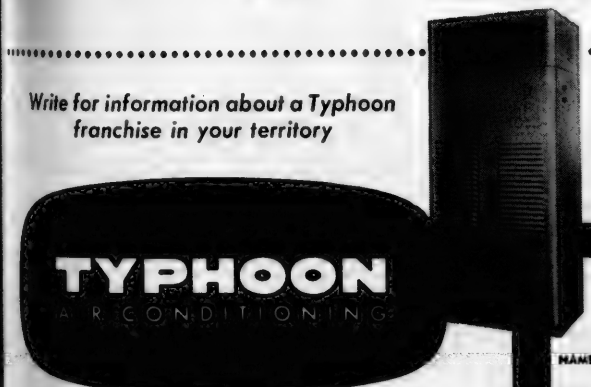
2 YOUR PARTNER, THE DISTRICT MANAGER ... when there's a complicated job to figure ... your Typhoon district manager is there to help you.

3 TOPNOTCH ENGINEERING • Typhoon units, open or hermetic, are ruggedly built with plenty of reserve capacity.

4 COMPLETE LINE of packaged air conditioners from 2 to 25 tons. You always have just the size unit your customer wants—when he wants it—competitively priced. You're set up to handle any job in town—efficiently, economically.

5 REGIONAL TRAINING SCHOOLS • intensive sales-engineering course by factory experts, conducted in your own territory. Every employee who attends is worth more money to you!

Write for information about a Typhoon franchise in your territory



Air Conditioning Units 2 to 25 tons • Multi-Packaged Systems up to 60 tons • Evaporative Condensers • Packaged Water Chillers • Air Handling Units... and Typhoon leads in air conditioning for the home — with a complete line of year-round heating-cooling units and heat pumps.

Specialists in Air Conditioning since 1909

TYPHOON AIR CONDITIONING CO., INC.
794 Union Street · Brooklyn 15 · New York

Typhoon Air Conditioning Co., Inc. V-2
794 Union St., Brooklyn 15, N. Y.

I would like to know more about the Typhoon Franchise.

NAME_____
FIRM_____
ADDRESS_____
CITY_____ ZONE_____ STATE_____

A hot air blanket halts penetration at the critical point.

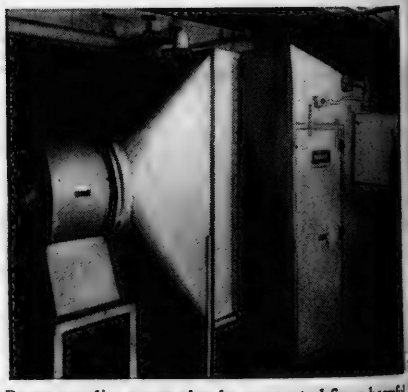
Turning Heat On "Big Bertha"

GUARANTEES PAPER QUALITY, SPEEDS PRODUCTION

Coating Diazo duplicating paper is tricky business. Special sensitizing solutions must penetrate it—but only to an exact, pre-determined depth. "Big Bertha", the world's largest drier, is Ozalid's answer. In six temperature control zones, a hot air blanket halts penetration at the critical point, keeps a constant moisture content in the 975 feet of paper processed every minute.

To assure positive control, J. O. Ross Engineering Corp. specified Westinghouse fans for this drier. Teamed up with PRECIPITRON®, the electronic air cleaner, they handle 95,500 cfm of dirt-free, high-temperature air twenty-four hours a day. Rugged, dependable Silentvane® Fans need little maintenance, give long service at low operating cost.

Westinghouse offers a complete line of air handling, air conditioning and air cleaning equipment. We can help you *put air to work*, too. Call your local Westinghouse-Sturtevant office. Westinghouse Electric Corporation, Sturtevant Division, Hyde Park, Boston 36, Massachusetts.



Paper quality must also be protected from harmful airborne dirt. So Westinghouse PRECIPITRON, the most efficient commercial air cleaner available today, is used. Seven of these units remove even the tiniest particles from the air by electronic attraction.

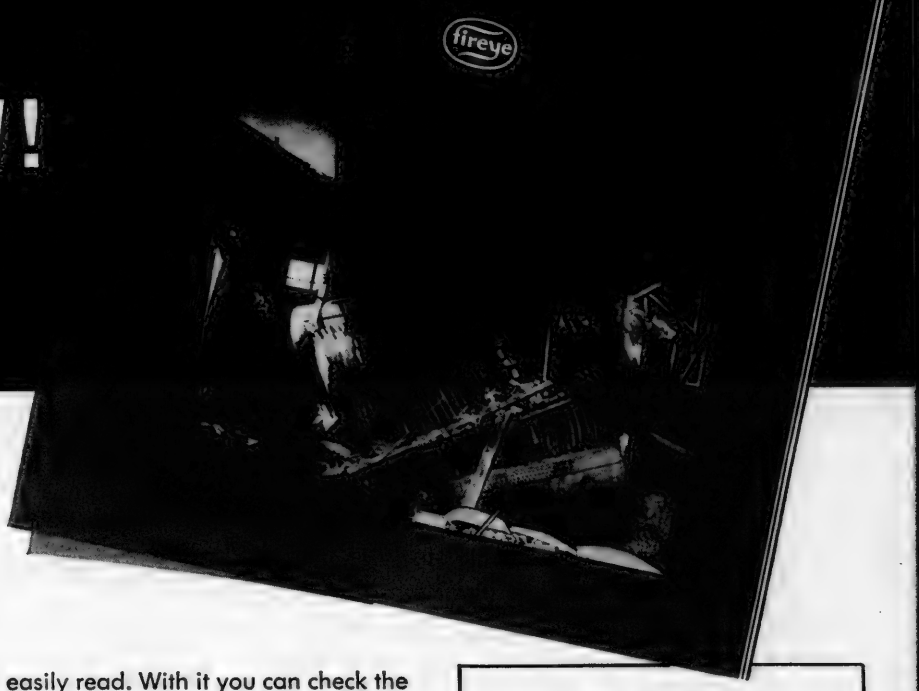
WESTINGHOUSE AIR HANDLING

YOU CAN BE SURE... IF IT'S Westinghouse

J-80324

Guarding Your Properties Against

It's you need to read this booklet NOW!



ecords show the chances are -to-1 you are NOT rotected against explosion azard, if you burn fuel for eat, power, or processing.

HEN A BURNER flame fails without stant cut-off of fuel, an explosive ixture collects . . . and may ignite sastrously on hot firebricks. A delay only 30 seconds can spell tragedy, et most "safeguards" in use today mply do not act that fast!

What can you do for proper protection . . . ?

ou can do a great deal, easily, inxpensively. First, send for this free ooklet. "Guarding Your Properties gainst Flame-Failure Explosions" is primer on such hazards, quickly and easily read. With it you can check the protection you now have, and determine the protection you really need. Money-wise it could prove to be the most important booklet you've ever read.

PLAY SAFE! SEND TODAY!

Fire insurance records show that flame-failure explosions happen regularly . . . and **they are costly.** Consider that your properties may be next, and mail the coupon *now!*

Who wrote this authoritative guide . . . ?

It has been compiled by the pioneers of *instant* electronic flame-failure protection. Long experience in the research and manufacturing of Fireye Flame-Failure Safeguards makes Combustion Control Corporation the one company best qualified to write on this subject . . . and the one company who can offer you Firetron — the flame-failure sensitive cell that's unrivaled for dependability.

ST and FOREMOST
IN INSTANT
PROTECTION

fireye

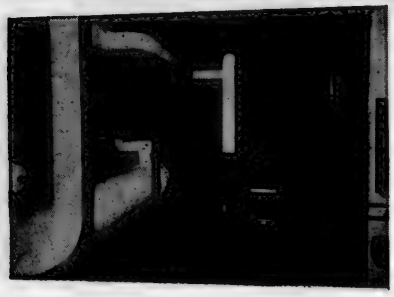
COMBUSTION CONTROL CORPORATION
Dept. HB-2, 718 Beacon Street, Boston, Mass.

Please send me your FREE booklet,
"Guarding Your Properties Against Flame-Failure Explosions".

Name.....

Firm.....

Address.....



The First Church of Christ Scientist in West Palm Beach where an Acme heat pump maintains year 'round temperature control.

One view of the Acme heat pump installation.

EVEN FLORIDA'S CLIMATE IS IMPROVED

by *Acme* HEAT PUMP

Heating and cooling requirements of Florida buildings call for an installation that can handle efficiently the variable loads and long operating hours of the summer months without sacrificing economy of operation when the heating cycle becomes necessary in the winter months. The Acme heat pump of the First Church of Christ Scientist in West Palm Beach meets those requirements.

The unit installed by John H. Couse, one of Florida's oldest Air Conditioning and Refrigeration contractors, is designed around an Acme Dry-Ex Water Chiller and other proven components. The Consulting Engineer on the installation was John O. Brey of Tampa, Florida. During the cooling season, the equipment will produce approximately 60 tons of cooling and its heating capacity in the winter is approximately 765,000 BTU/hr. Mr. Couse reports that the year-round performance has been very satisfactory. This is just one of many efficient Acme installations. *When you specify on your next job, investigate Acme first.*

ACME AIR CONDITIONING REFRIGERATION

ACME INDUSTRIES, INC.

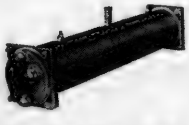
Mfgs. of a complete line of Air Conditioning and Refrigeration Equipment

JACKSON, MICHIGAN

Evaporative Condensers
Cooling Towers
Floor-type Unit Coolers

Direct Expansion (Dry-Ex) and Flooded Liquid Chillers

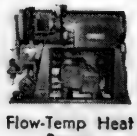
Heat Exchangers, Oil Separators



Shell and Tube, Shell and Coil Condensers

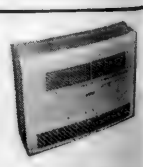
Receivers, Pipe Coils

Packaged Liquid Chillers to 225 tons



Flow-Temp Heat Pumps

Flow-Cold Liquid Chillers.



Remote Room Conditioner

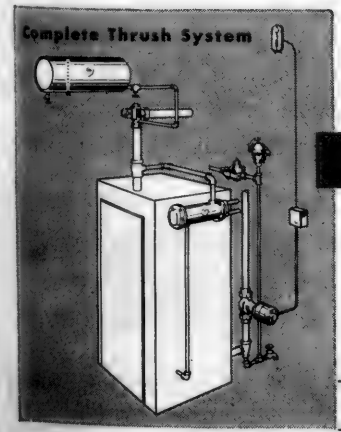
Continuously serving the air conditioning and refrigeration industry since 1919

LOOK FOR THE Vacuum Breaker *

WHEN YOU BUY PRESSURE TANKS

SAVE TIME! Save labor! Reduce service bills! Please your customers. How? Just insist on genuine Thrush Pressure Tanks for the hot water heating installations you make. Only Thrush Pressure Tanks have the built-in Vacuum Breaker which enables you to drain a waterlogged tank completely in just a few minutes. Best of all, this feature costs no more!

This is only one of the many advantages you can give your customers and yourself when you install Thrush equipment. Ask your wholesaler about it or use the coupon below.



H. A. THRUSH & COMPANY

MAIL COUPON NOW FOR MORE INFORMATION

H. A. THRUSH & COMPANY
Department D-2, Peru, Indiana

Your built-in Vacuum Breaker feature of Thrush Pressure Tanks sounds valuable to us. Please send literature describing it.

NAME _____

ADDRESS _____

Pliotron—T.M. The Goodyear Tire & Rubber Company, Akron, Ohio

NEW HIGH EFFICIENCY

ELECTROSTATIC AIR FILTER

PLIOTRON is its name. It's the world's first washable, self-charging electrostatic filter.

This new air filter actually attracts and captures up to five times as many fine particles as ordinary, non-electrostatic filters as proved by the Weight/Smoke test. It picks up particles as small as some of the solids in cigarette smoke.

PLIOTRON looks and installs like regular replacement filters. It slips into standard filter holders in most heating or air conditioning systems. But there the similarity ends. Its permanent, natural static electric charge gives you an efficient cleaning action that does not wash off or wear away. And when it's dirty, a quick bath restores it to "like new" efficiency. All this adds up to cleaner, healthier air longer and at lower cost.

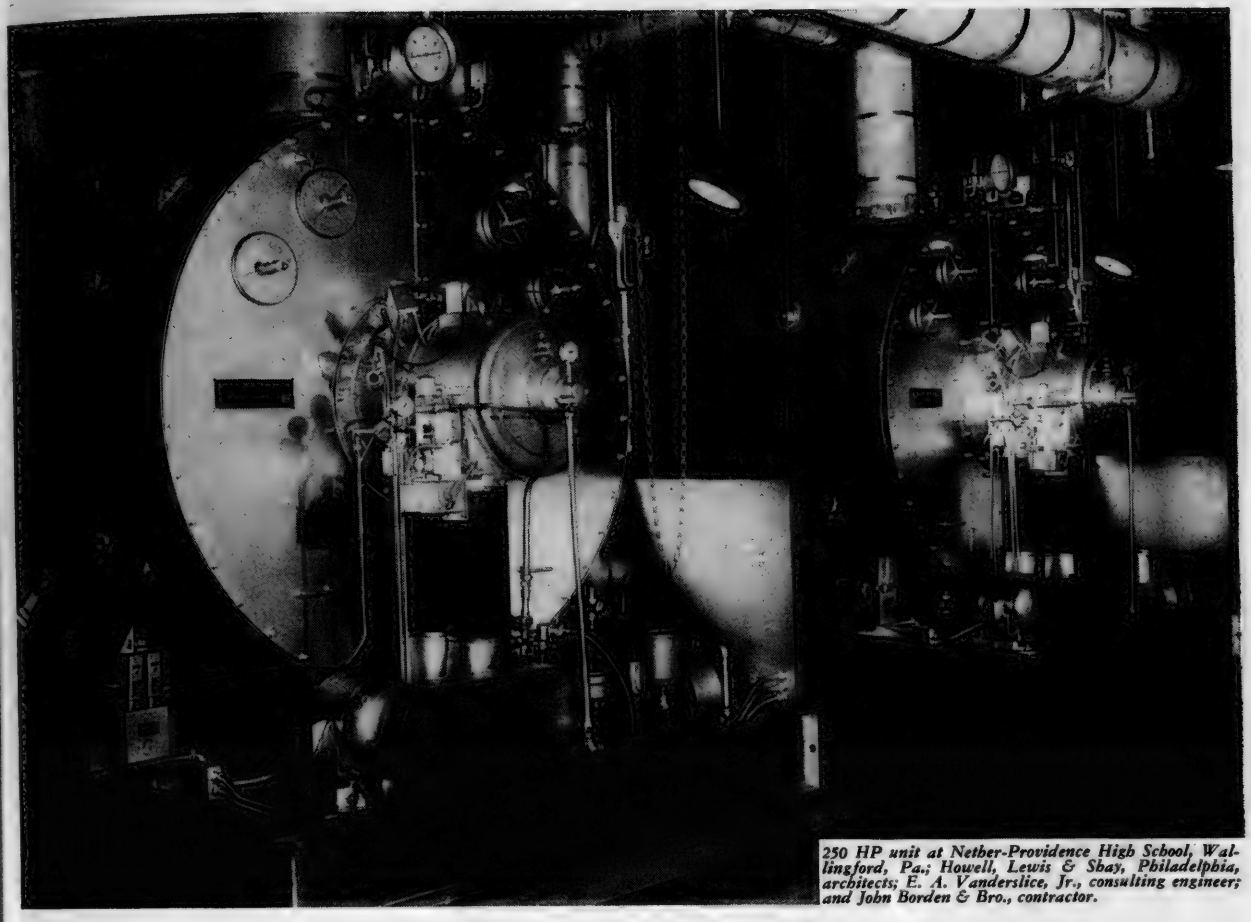
PLIOTRON has been proved in laboratory tests and actual use. Reports from the field indicate it is doing an outstanding job of removing not only dust, soot and pollen, but also such diverse materials as diamond dust, air-borne spores and bacteria from the air. Whenever you need clean air, put in PLIOTRON. Get full details from your heating or ventilating distributor or by writing Goodyear, Pliotron Sales, Akron 16, Ohio.

GOODYEAR

THE GREATEST NAME IN RUBBER

We think you'll like "THE GREATEST STORY EVER TOLD"—every Sunday—ABC Radio Network—THE GOODYEAR TELEVISION PLAYHOUSE—every other Sunday—NBC TV Network

at SCHOOLS and COLLEGES



250 HP unit at Nether-Providence High School, Wallingford, Pa.; Howell, Lewis & Shay, Philadelphia, architects; E. A. Vanderslice, Jr., consulting engineer; and John Borden & Bro., contractor.

Powermaster® Excells in All Tests

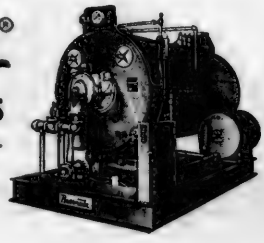
ALL OVER AMERICA, steam and hot water requirements for public and parochial schools, private schools, trade schools, and colleges are being supplied by *Powermaster* Packaged Automatic Boilers . . . with an outstanding record of reliability and economy. Why have they been so widely "accepted" in educational circles by men who can evaluate the aptitude of boilers for this particular kind of service? Because by all standards of comparison, *Powermasters* possess these qualifications for "enrollment" in any kind of school: Ease and economy of installation—space-saving compactness—fuel-saving smokeless combustion—fuel-saving operation at *all* loads—maintenance-saving accessibility—completely automatic operating and safety controls—minimum attention of service personnel.

Compare *Powermaster* with any other packaged boiler and you'll understand why it is today's best buy for institutions of learning . . . or buildings . . . or hospitals . . . or industrial plants. Send for latest descriptive bulletin.

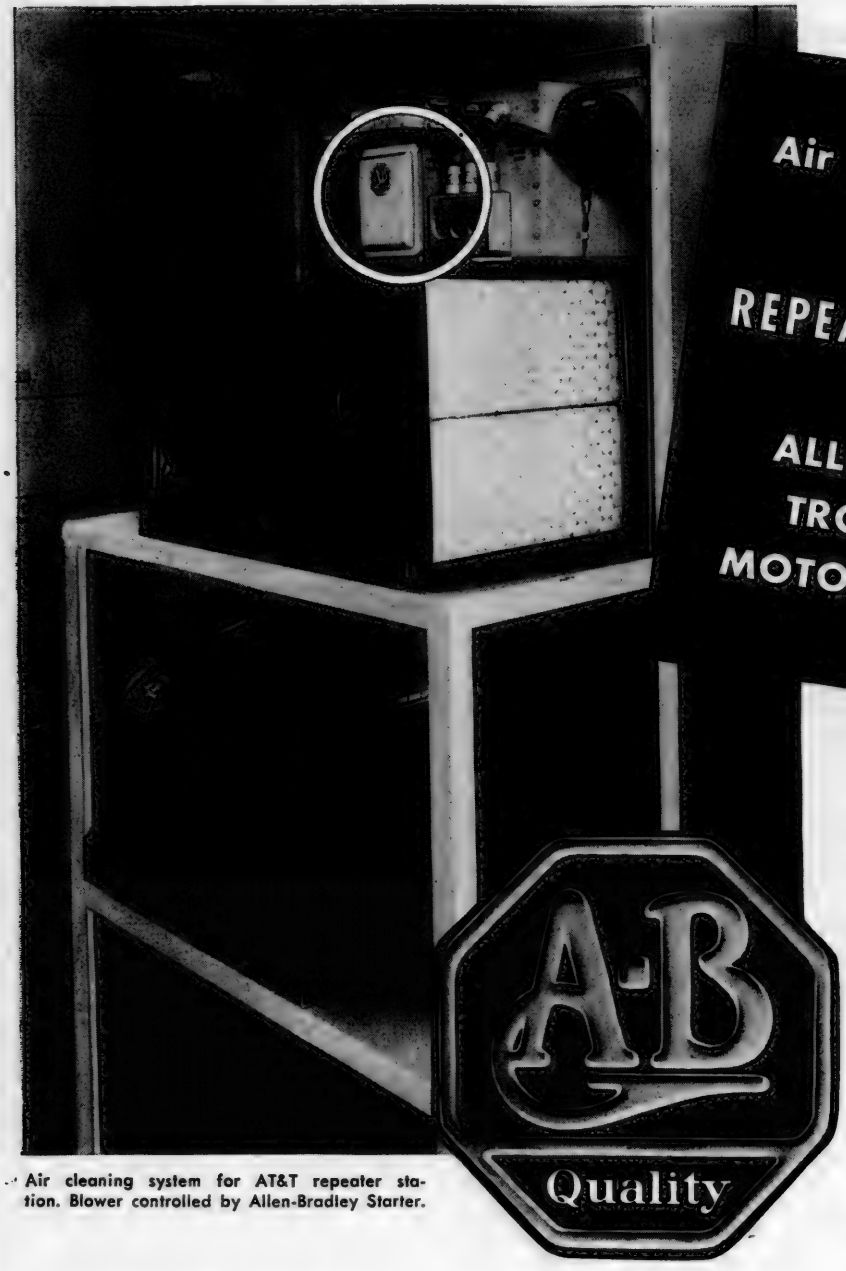
O·S *Powermaster*®

PACKAGED AUTOMATIC BOILERS

In sizes to 500 HP; pressures to 250 psi.



ORR & SEMBOWER, INC. • Established 1885 • **Morgantown Road, Reading, Penna.**



Air cleaning system for AT&T repeater station. Blower controlled by Allen-Bradley Starter.

Air Cleaning System Blowers for AT&T REPEATER STATIONS

equipped with

ALLEN-BRADLEY TROUBLE FREE MOTOR CONTROLS

A-B Quality

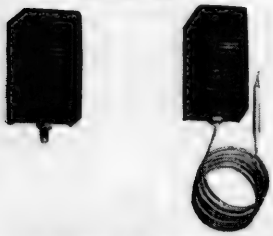
Clean air is needed to secure proper cooling of vacuum tubes in American Telephone & Telegraph repeater stations. Blowers, fitted with special filters and controlled by reliable Allen-Bradley controls, provide the required flow of clean air.

Why are Allen-Bradley starters so popular for air-conditioning service? . . . Because they do not require regular attention, they are trouble free. Only ONE moving part. No pivots, pins, or bearings to corrode or stick . . . no jumpers to break. You install them . . . and forget them! Furthermore, Allen-Bradley cadmium silver alloy contacts never need cleaning, filing, or dressing. Dependable overload relays remain accurate in their operation, even after long service.

Allen-Bradley Co.
1330 S. Second St., Milwaukee 4, Wis.

Typical Refrigeration Controls

PRESSURE AND TEMPERATURE CONTROLS

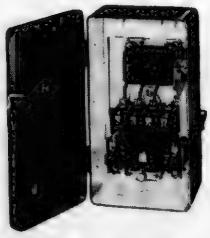


A-B Bulletin 836 pressure control and A-B Bulletin 837 temperature control. Accurate, rugged, compact units.

AUTOMATIC STARTER

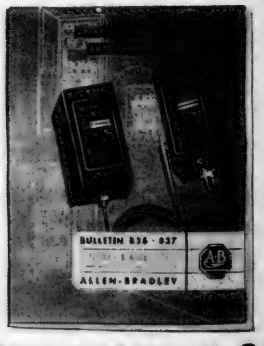
A-B Bulletin 709 solenoid starter. Note white interior for ease of wiring.

COMBINATION STARTER



A-B Bulletin 712 disconnect switch type combination starter. Saves installation time.

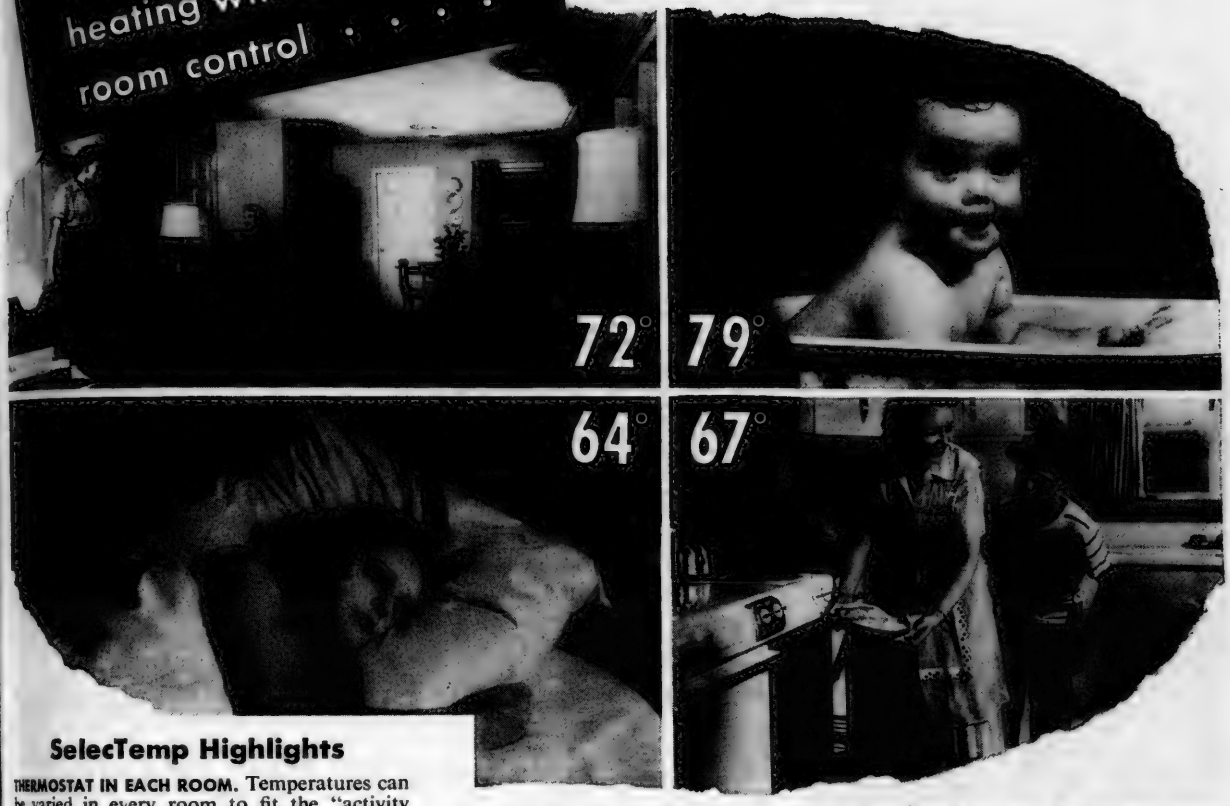
Write **for This Allen-Bradley Air Conditioning and Refrigeration Bulletin**



ALLEN-BRADLEY SOLENOID MOTOR CONTROLS

At last . . . continuous modulated heating with individual room control . . . .

SelecTemp TRADE MARK HEATING



SelecTemp Highlights

THERMOSTAT IN EACH ROOM. Temperatures can be varied in every room to fit the "activity plan" and personal preference of the occupants.

MODULATED HEAT. Air circulation is continuous. Both temperature and volume of air is automatically modulated, as required to offset heat loss from room.

FILTERED, CIRCULATED AIR. Individual room air circulation prevents transmission of odors or bacteria from other rooms. Air is cleaned by a spun glass filter in each room unit. Filtered outside air can be introduced if desired.

BOILER LOCATION. Does not require centrally located heating plant. Boiler can be placed in any desired location, with proper distribution of heat to every room.

LOW POWER COST. No electricity required to operate circulating fans. Nonelectric thermostats.

LOW INITIAL COST. No other system can be so easily installed in either new or old construction. Small soft copper tubing (¼ inch I.D.) carries steam to individual room heater units. Return lines are ⅛ inch. Tremendous savings in installation costs.

LOW FUEL COST. Temperature easily reduced in unused rooms. Eliminates overheating.

AUTOMATICALLY BALANCED. No special adjustments of dampers, valves or orifices required to balance heating system. Each unit continuously regulates heat needed for each room. Automatically compensates for external heat sources such as fireplace or solar heat, without affecting temperatures of other rooms.

important announcement by Iron Fireman

Iron Fireman SelecTemp is a distinctively new method of comfort heating. It has been in actual use for three years and is giving outstanding performance in all types of buildings, from small homes to motels, apartment houses and office buildings.

Heating engineers have long recognized the need for accurately *modulated* heat (in contrast to the old "on-and-off" method of heat control), with individual room control. The modern trend toward extended floor plan and "picture" windows makes zone control essential for true heating comfort.

Until now, only those who could afford the very high cost of an elaborate heating plant and complex control system could enjoy a modulating flow of heat with control in *each room.*

Iron Fireman SelecTemp combines all of these desirable elements in such a simple and practical way that the ultimate in heating comfort can now be enjoyed in the smallest home or the largest residential, institutional or commercial building. Ideal for both new construction and modernization.

Write for descriptive booklet and specifications to Iron Fireman SelecTemp, 3154 W. 106th St., Cleveland 11, Ohio.

SelecTemp TRADE MARK

PRODUCT OF IRON FIREMAN

Send for full information

Copyright, 1953-I. F. Mfg. Co.

IRON FIREMAN MANUFACTURING CO.
3154 W. 106th Street, Cleveland 11, Ohio.
Please send literature on Iron Fireman SelecTemp heating.

Name_____

Address_____

City_____ State_____

OAKWOOD HOSPITAL — Architects: Stanton & Hillier. Consulting Engineer: George Wagschal Associates. Building Contractor: W. E. Wood Company. Heating Contractor: Page Plumbing and Heating Company.

American Blower primary and secondary fans supply heated air to rooms, offices, dining room, kitchen and corridors. Surgery, with its precise requirements for specially conditioned air, also depends on American Blower equipment. The kitchen unit relies on an American Blower sprayed coil dehumidifier.

"Ventilation was a major factor in planning for the health and comfort of our patients"

— FRED BECHTOL, BUILDING SUPERINTENDENT, OAKWOOD HOSPITAL

Proper balance of air between supply and exhaust is air handling equipment's biggest job. Oakland Hospital used a total of 10 American Blower HS fans (two are shown here) to handle air exhaust.

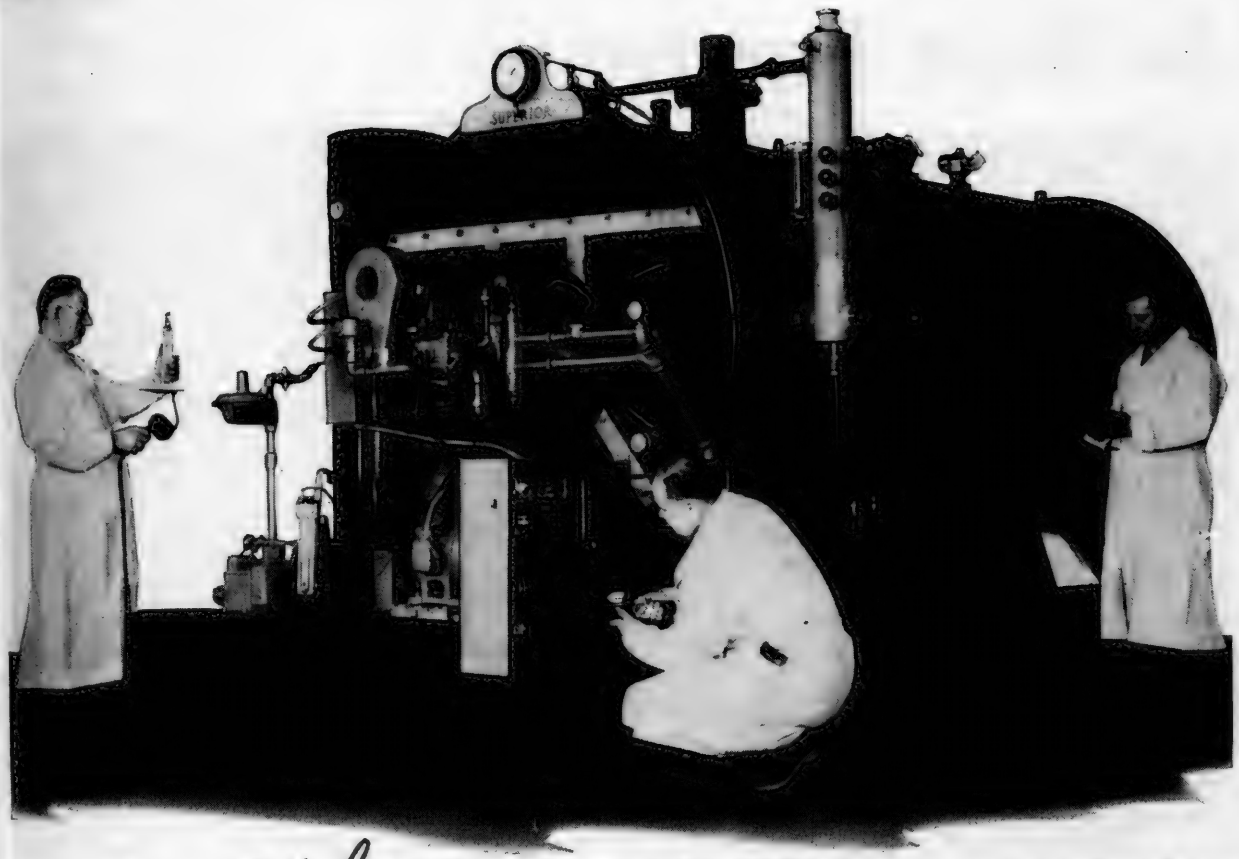
Air handling equipment in a modern hospital must be dependable and quiet in operation. The health and comfort of the patients demand it. At Oakwood Hospital, $5 million medical center in Dearborn, Michigan, American Blower air handling equipment was specified.

Fred Bechtol, Building Superintendent, appreciates the way American Blower equipment is built to run continuously at rated capacities, with no breakdowns and minimum maintenance expense. American Blower engineers welcome the opportunity to cooperate with you. If you have an air handling problem, give your nearest American Blower or Canadian Sirocco Office a call.

AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO
Division of American Radiator & Standard Sanitary Corporation

YOUR BEST BUY AMERICAN BLOWER AIR HANDLING EQUIPMENT

Serving home and industry: AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS & WALL TILE • DETROIT CONTROLS • KEWANEE BOILERS • ROSS EXCHANGERS • SUNBEAM AIR CONDITIONERS



Completely FACTORY ASSEMBLED and TESTED ...for a GUARANTEED RESULT

There's no guesswork about the performance of a Superior Steam Generator. Complete factory assembly followed by efficiency tests conducted *at the factory* under actual firing conditions guarantee operation at more than 80% thermal efficiency.

And because they are completely factory assembled and factory tested, they arrive at your plant ready to go to work . . . *backed by undivided responsibility*.

Fully automatic, firing either gas or oil, installation is simplified and inexpensive. Their rigid channel iron base eliminates the need of special foundations. Superior's built-in induced draft makes an expensive chimney unnecessary. All interconnecting piping and wiring is completed at the factory . . . ready for connection to supply services and steam outlet.

When the accent is on modernization, buy a Superior Steam Generator. It's the modern way to buy economical steam.

Five Superior Steam Generators ranging in size from 30 to 600 b.h.p. on the test line at the Superior plant in Emmaus, Pa.

18 sizes from 20 to 600 b.h.p. for pressures up to 250 p.s.i. or for hot water. For complete details, write for Catalog 619.

for performance you can **BANK** on

SUPERIOR COMBUSTION INDUSTRIES INC.
TIMES TOWER, TIMES SQUARE, NEW YORK 36, N.Y.

SUPERIOR
STEAM GENERATORS

Is Your Factory Starved for AIR?

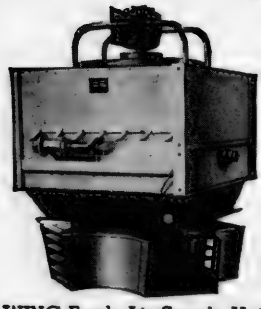
If this is what happens when you go from the office out into the shop, your plant is starved for air! The vacuum created by the operation of necessary exhaust equipment is usually responsible. While our pictures may be slightly overdrawn, something like that may be happening in your plant.

If your building is not new, the vacuum may be relieved by crevices, loose-fitting doors, windows, and open doors which will admit so much unheated air that a great deal of discomfort may be caused and your present heating system will be entirely inadequate.

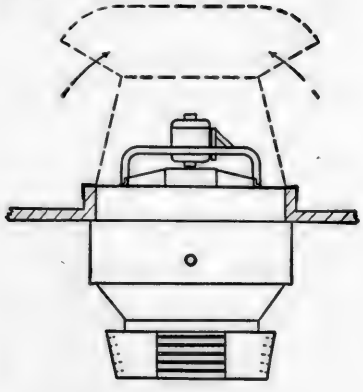
If the building is tight—no excess crackage and no frequently opening doors—the ventilating system which you so painstakingly designed and installed to protect your employees and increase production won't work properly, unless you make special provisions for delivering into the building an amount of warmed air at least equivalent to that which your exhaust system will take out.

There is an easy solution. Install WING FRESH AIR SUPPLY HEATERS with Revolving Discharge Outlets. In winter they bring in fresh air through heating coils varied to just the right temperature, replacing exhausted air. In summer, with the steam turned off, they circulate the air in your plant, giving a cool, refreshing sensation to the workers and keeping production up to normal in stifling weather.

WING FRESH AIR SUPPLY HEATERS



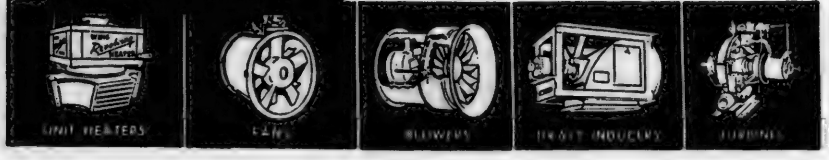
WING Fresh Air Supply Unit with fan enclosed in casing.



(Right) WING Fresh Air Supply Unit with fan above roof line.

Wing

L.J. Wing Mfg. Co. Linden, N.J.
158 Vreeland Mills Road
Factories: Linden, N.J. & Montreal, Canada
In Europe: Etab. Wanson, Brussels, Belgium



MOTORIZED CHIMNEY DRAFT

with the WING DRAFT INDUCER

No boiler can operate satisfactorily or efficiently over wide ranges of weather or load with variable natural draft. The fuel—whether oil, gas or coal—must have enough oxygen for complete combustion. There must be sufficient draft or furnace fires will be slow burning and lifeless, resulting in uneven, insufficient and irregular heat.

WING Draft Inducers insure positive, adequate, uniform draft regardless of variable weather conditions or inadequate chimney or breeching construction.

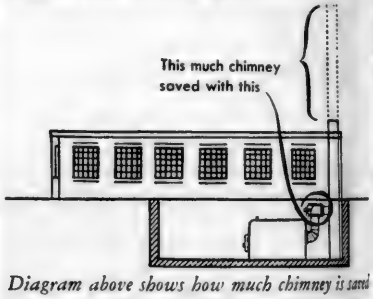


Diagram above shows how much chimney is saved by installing Wing Draft Inducers.

Wing Draft Inducers are suitable for use in connection with oil, gas, stoker-fired or hand-fired heating boilers, industrial furnaces or kilns, or high pressure steam boilers, either stationary or marine. Sizes are available for boilers as low as 1000 sq. ft. E. D. R. up to steam generators producing 100,000 pounds of steam/hr. Special, heavy duty designs available for these larger boilers.

Wing Draft Inducers are made in two types—for insertion in breeching or flue, or for installation on top of a chimney. Write for a copy of Bulletin I-52 to L. J. Wing Mfg. Co., 158 Vreeland Mills Road, Linden, New Jersey.

1 of the many reasons why you will find it pays to sell Chrysler Airtemp

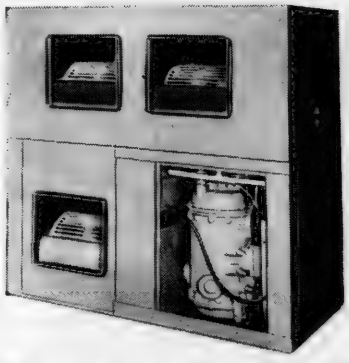
Advanced Engineering which offers your prospects

features that DO more!

• The originator of "Packaged" Air Conditioning has always been steps ahead in engineering features which mean more to the prospect because they *do more* for him. The famous Chrysler Airtemp radial-design compressor operates more efficiently and more quietly. "Maxi-Fin" Coil steps up cooling efficiency. "Airfoil" Grille provides a greater range of adjustments of the air flow pattern. And so, right down the line, every one of the many exclusive features of a Chrysler Airtemp "Packaged" Air Conditioner conveys a definite benefit to the buyer.

There are more reasons, too, why you will find that it pays to sell Chrysler Airtemp—the "Packaged" Air Conditioning which most people buy (according to the 17-year sales record). Take a minute now to check those reasons stated below. Then fill out and mail the convenient coupon for complete details of your opportunity to make more money with Chrysler Airtemp —the first name in "Packaged" Air Conditioning.

"Packaged" Air Conditioners in six water-cooled models from 2 to 15 H.P.



New "Packaged" Air-Cooled Air Conditioners— *no water needed,* no plumbing required. 2, 3 and 5 H.P.

Guaranteed by Good Housekeeping

7 more advantages you sell with when you sell Chrysler Airtemp...

★ **Consumer Confidence**—people know the Chrysler Airtemp name—associate it with engineering leadership—have confidence in the products which carry it.

★ **More Units in Use**—Chrysler Airtemp pioneered "Packaged" Air Conditioning in 1937, has more units in use today than any other manufacturer.

★ **Lower Installation Cost**—super-quiet operation permits use within or very close to areas to be cooled, reducing amount of ductwork required. All units shipped completely factory-assembled and tested.

★ **Assured Dependability**—all units manufactured to exacting standards of precision in a windowless, completely air conditioned factory. Each unit is thoroughly inspected and tested, using special equipment and methods, to assure dependable performance in the field.

★ **More Complete Line**—9 models meet all requirements.

★ **More National Advertising** to all prospects and specific benefit advertising to individual businesses—the best markets for "Packaged" Air Conditioning.

★ **More Local Selling Helps**—the broadest line of tested and proved local selling helps for dealers.

CHRYSLER AIRTEMP

heating • air conditioning for homes, business, industry

Airtemp Division, Chrysler Corporation, Dayton 1, Ohio

Airtemp Division of Chrysler Corporation H&V-2-54
P.O. Box 1037, Dayton 1, Ohio

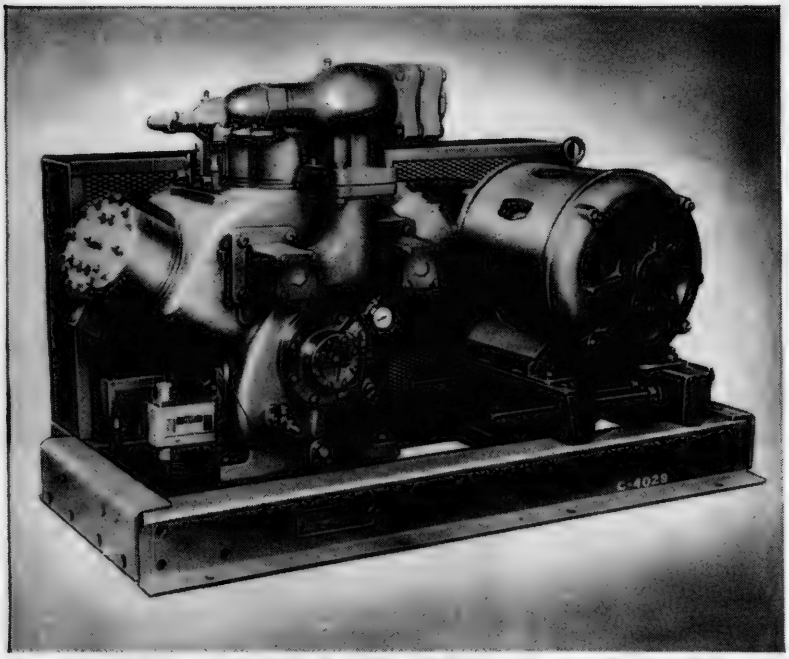
I would like to know more about the Chrysler Airtemp Franchise.

Name_____

Address_____

City_____ Zone____ State_____

The whole industry's talking about Worthington's new Freon compressor



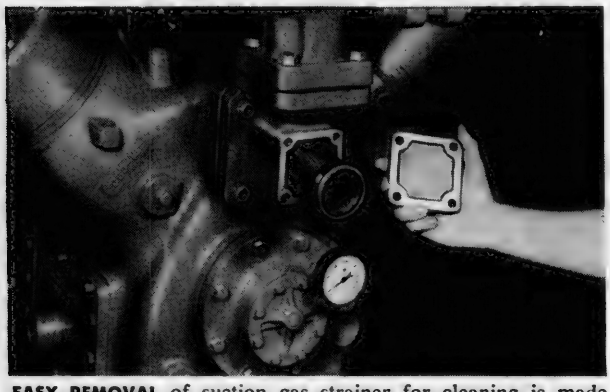
TRIM, STURDY CONSTRUCTION marks this 4JF6 compressor unit — 50-60 hp, six cylinder W-type compressor. The complete compact unit consists of fabricated steel base, compressor with valves, gauges and safety controls, drive and safety guard. Designed to operate in conjunction with Worthington evaporative condensers in localities where city water is scarce or high in cost. Also available with shell and tube condenser. Complete range from 3-150 hp.

"The high capacity unit we've been waiting for!"

"Greater operating efficiency!"

"There's nothing else like it!"

And every comment you hear is true! The refrigeration compressor is the most vital element of any air conditioning or refrigeration system. That's why Worthington spent years in developing the new "J" Freon compressor. That's why Worthington invested over a million dollars in compressor research. *And that's why you can't find its match in any other unit.* Only a few features of the new "J" Freon compressor are highlighted here — get the full story by contacting your nearest Worthington district office or write to Worthington Corporation, Air Conditioning and Refrigeration Division, Section A.4.33, Harrison, New Jersey.



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LORD & TAYLOR'S new West Hartford, Conn., store depends on Worthington to provide comfortable air conditioning for its customers. Two 150 hp "J" compressors and two evaporative condensers make up the highly efficient Worthington air conditioning team at this modern store.

A.4.33

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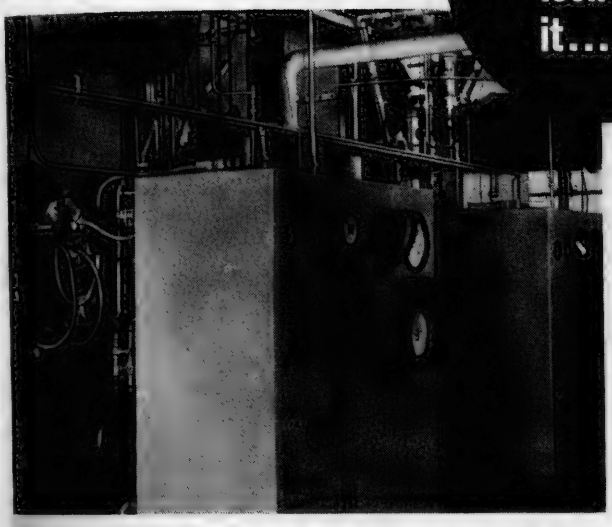

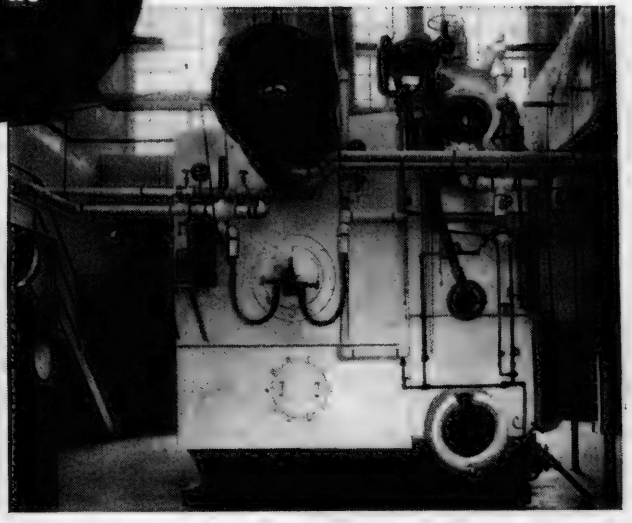

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is compact, portable, simple, reliable

Almost one and one-half million pounds of steam capacity for building heating and allied services already have been credited to the B&W Integral-Furnace, Type FM. This shop-assembled unit, for steam loads between 2900 and 28,000 lb per hr at pressures to 235 psi, enjoys such wide popularity with users in a broad range of industrial, commercial, institutional and other classifications that, today, FM Boilers are in service or on order for a total steam capacity of more than 7,000,000 lb per hr.

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- Safe, Automatic Operation

Write for Bulletin G-76B, which details the cost-saving features of the B&W Integral-Furnace Boiler, Type FM. The Babcock & Wilcox Company, Boiler Division, 161 East 42nd Street, New York 17, N. Y.

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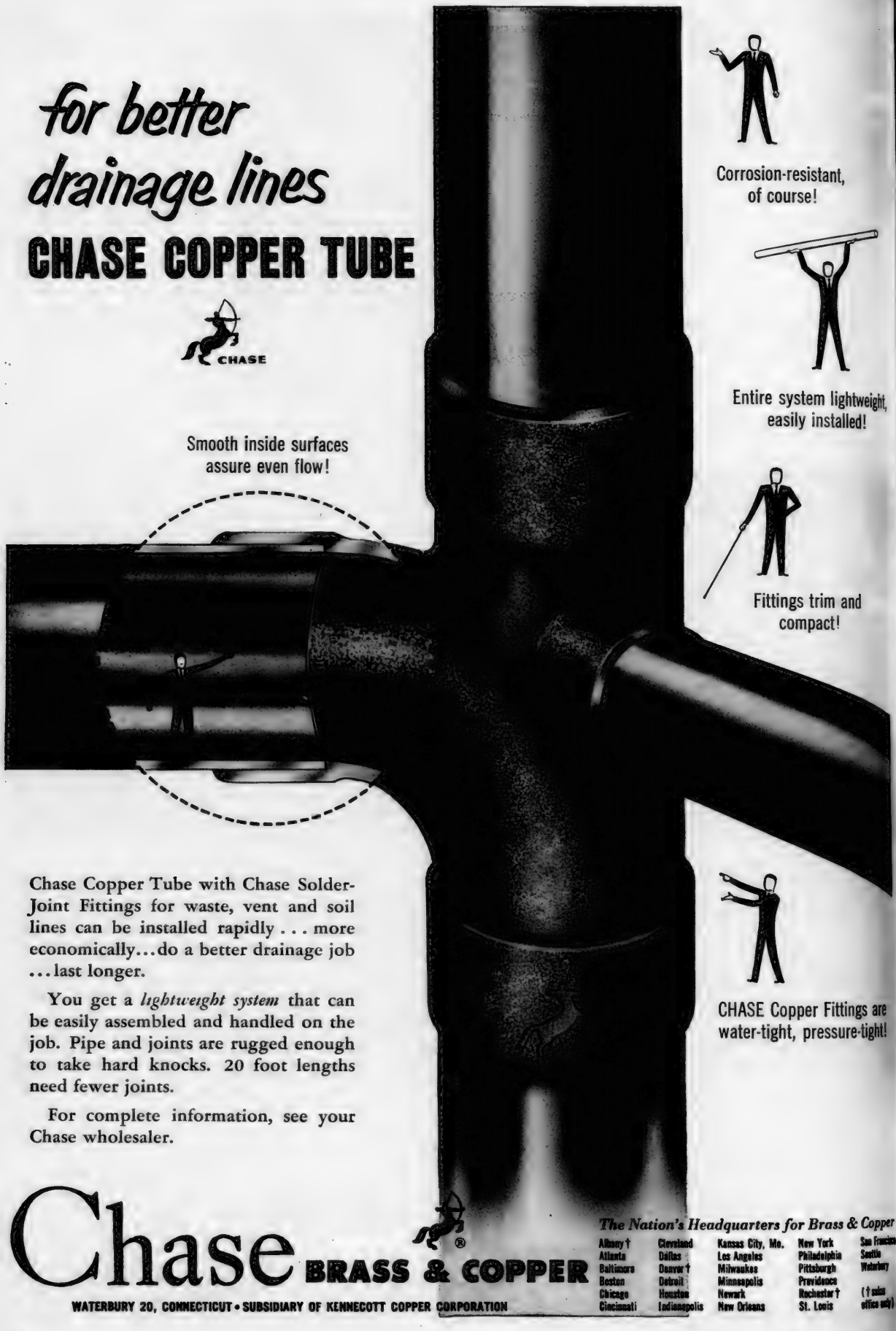

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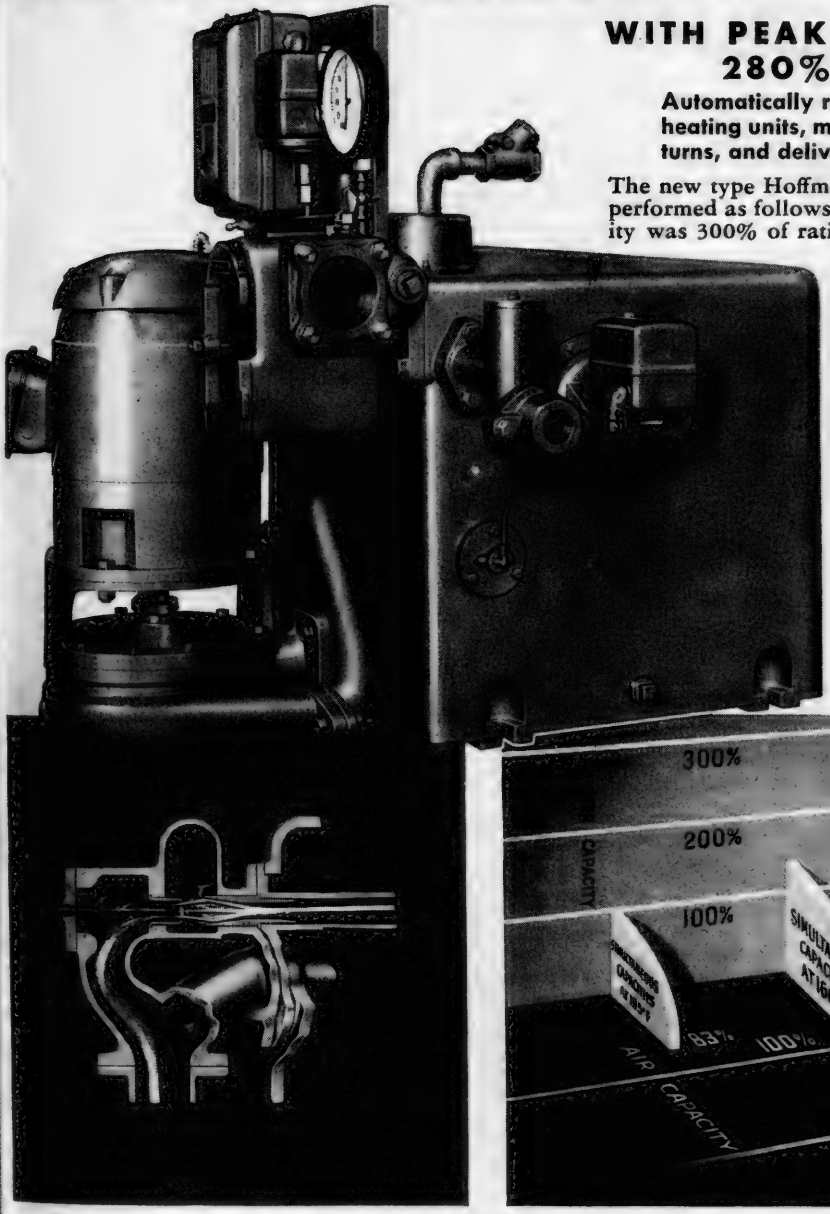
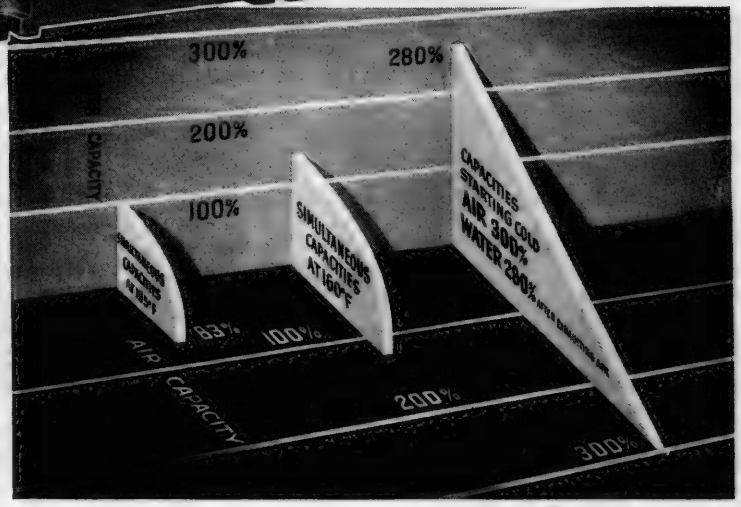
These Hoffman performance figures defy comparison. Remember, too, that all this super-efficiency is available at lower maintenance cost due to the featured Hoffman Jet-Type Vacuum Producer.





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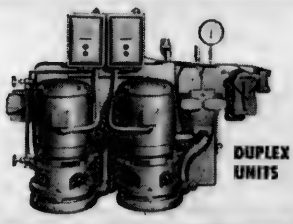

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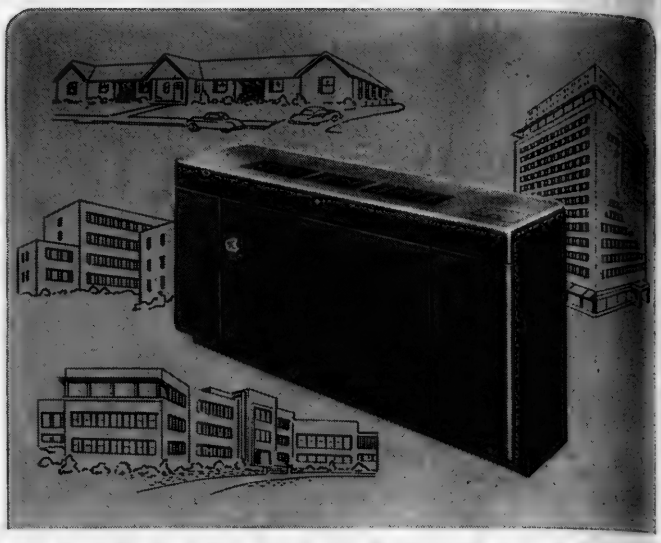
The REMOTAIRE
by AMERICAN-Standard

a new remote type unit for multi-room installations

Heats in Winter
Cools in Summer



For hotels, motels, apartments, hospitals, offices and industrial buildings and other types of installations.

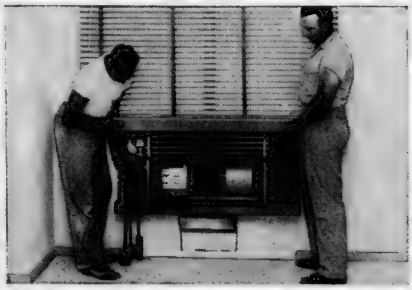
■ The Remotaire is an individual room remote type unit for providing year 'round air conditioning for central plant multi-room installations.

The Remotaire, as part of a Remotaire system, uses chilled water from a central water chiller for cooling and hot water from a central heating plant for heating. Individual control of each unit allows the occupant to choose the room temperature that suits him best without affecting adjoining spaces.

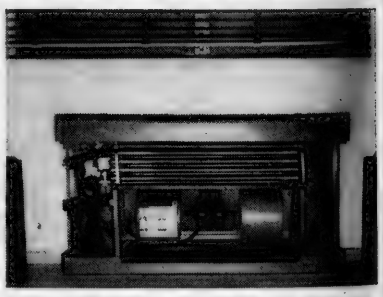
The Remotaire is enclosed in an attractive cabinet of sturdy, reinforced steel—plus a reinforced air grille—which adds to permanence and long-lasting beauty of unit. Designed for location under windows, this unit can be free standing or recessed into wall four inches.

The REMOTAIRE Wall Aperture System is ideal for New Construction

LOCATION READY for Remotaire shows wall aperture, water supply, return, and condensate pipe stubs, and wall plug for electrical connections.



REMOTAIRE is set in place and leveled. Piping and electrical connections are made and pipe insulation applied.



HERE IS THE REMOTAIRE (with panels removed) showing the piping and electrical connections and pipe insulation completed.

As shown in the pictures above, the Remotaire, as part of a Remotaire Wall Aperture System, can be readily installed in the average building since piping connections are the principal installation requirement. Ventilation air is introduced through a small wall aperture behind each unit thus eliminating use of large, expensive, space-consuming ductwork. Other Remotaire systems, using other methods of ventilation, are ideal for modernization as well as new construction. Write for Remotaire Brochure, Form 417.

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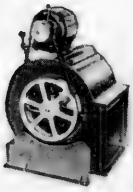
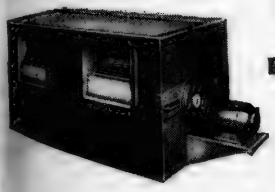
POWER ROOF VENTILATORS, Propeller Fan Type and Power Fixed (backward curve blade) offer a wide range of sizes. Bulletin No. 119 Propeller Fan Type Bull. 118, Power Fixed Fan Type.

BLOWERS, Squirrel Cage (Forward Curve) and Power Fixed (Backward Curve) Fans available in a complete range of sizes, Single or double width. Bulletin 101 (PF) Bulletin 105 (S.C.).



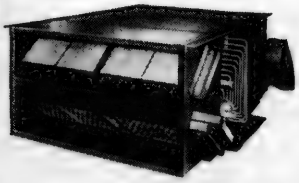
FURNACE FANS, Single, double or special width. All housing and wheel parts are die formed. Available as complete assemblies or parts only. Bulletin No. 115.



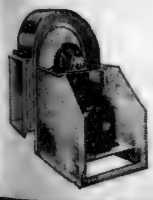
UNIT HEATERS, Blower Type floor or ceiling mounting arrangements, built in sections to facilitate efficient handling and erection. Popular sizes. Bulletin No. 112.

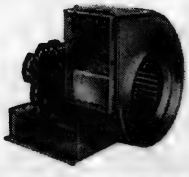
PROPELLER FANS, New Venturi-type Belt drive 24" to 48" wheel diameters, direct drive 12" to 30" diameters. A complete line of accessory items are available. Bulletin 117.

UNIVERSAL BLOWERS, A stock blower assembly made in single or double width, sizes 7" to 27" wheel dia. and features Universal discharge arrangement. Bulletin No. 110.



AIR CONDITIONING UNITS, Seven sizes available, ranging from 1,000 to 14,000 C.F.M. Vertical or horizontal mounting. Designed to combine cooling in summer, heating in winter. Bulletin 120.





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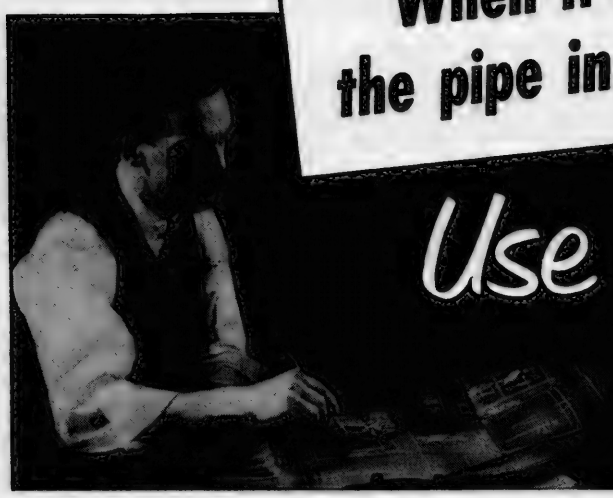

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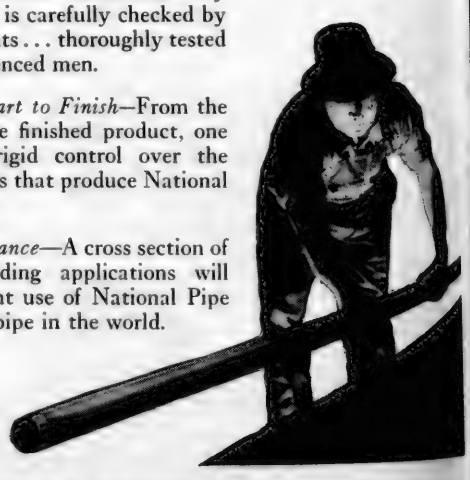

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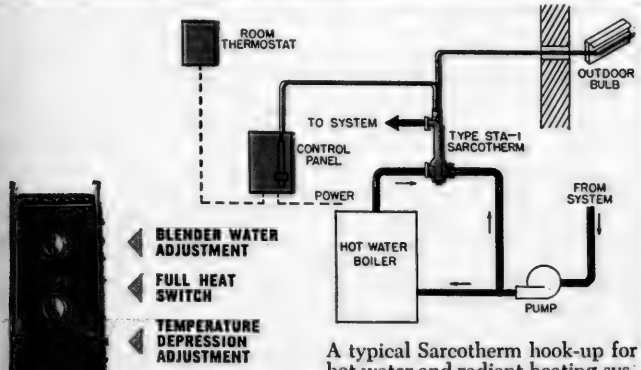

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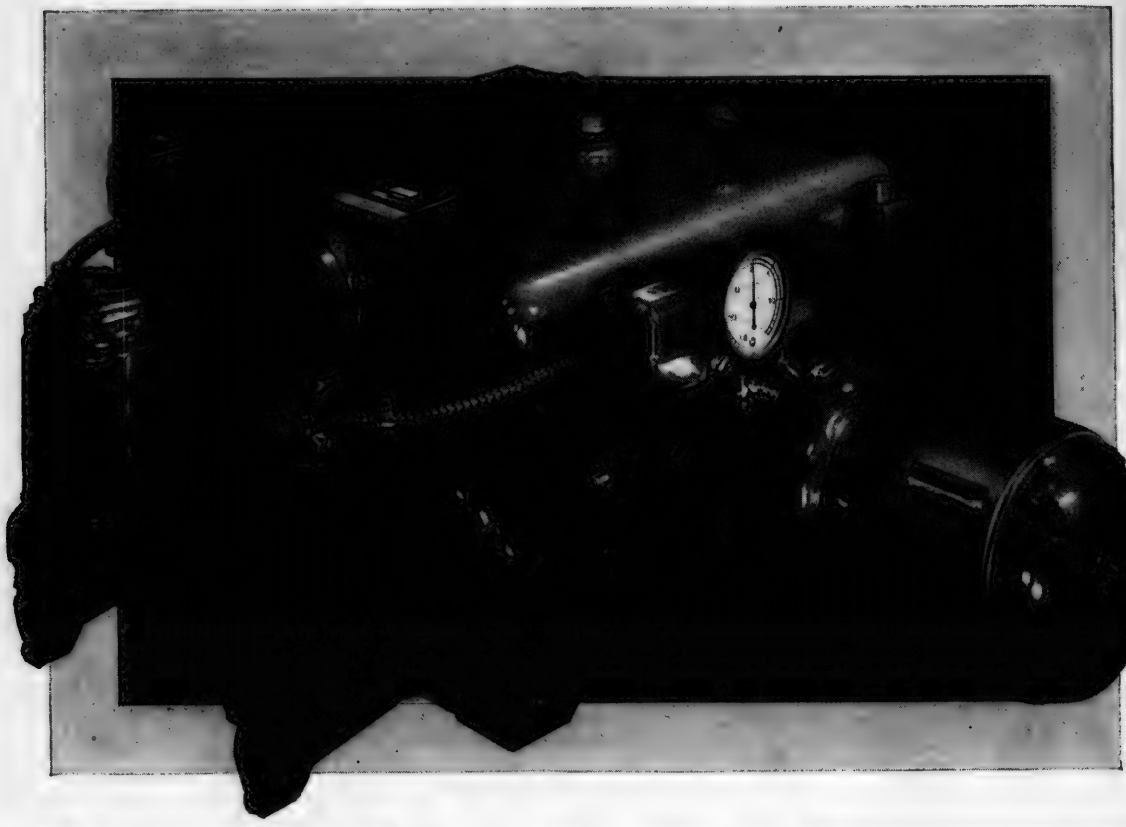

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These pumps possess many other features which permit a more efficient utilization of fuel and minimum use of electric power. Low, low, returns reduce installation costs and usually eliminate putting the pump in a pit. Simplicity and efficient operation reduce supervision and maintenance costs. Information regarding this new heating pump development is available immediately upon request.

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- Flexibility permitting addition of radiation without changing basic pump installation.
- Low, low, return line connection.

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CAPILLARY TUBE IMPROVES HEAT PUMP DESIGN

Fig. 1. Heat pump unit available as a 3 and 5 hp package.

G. L. BIEHN

Design Engineer, Westinghouse Electric Corp., Air Conditioning Division, Hyde Park, Mass.

The capillary tube is a tool that is being used to simplify heat pump design and to improve operation. This article discusses advancements in its use and also some of the limitations of the capillary tube.

THE capillary tube, a simple and reliable device to eliminate the conventional expansion valve, has become an accepted part of domestic refrigerators, water coolers, and other small capacity refrigeration packages. When the air conditioning industry extended the range of its units to include fractional horsepower systems for the cooling of single rooms, the capillary tube made its appearance in this field as well. Today its use in the window unit industry is practically universal.

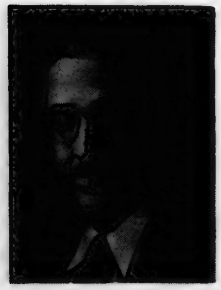
Refrigeration engineers are seeking ways of extending this range still further because of the system simplification provided. Although the capillary tube was first used with only the smallest capacity air conditioning units, it has gradually moved into one-horsepower and larger units with equal success. Completion of successful development work has resulted in extending the capillary tube to the heat pump system, and 3 and 5 hp package units, Fig. 1, have recently been announced. In the illustration, attention is directed to the capillary tube.

When the first Westinghouse window type heat pump appeared in 1940, it also used the capillary tube. Actually, its system as shown in Fig. 2 differed very little from that of the standard window unit except for the addition of the four-way valve. Here, apparently, was an even better use for the capillary tube than any of the previous ones. Whereas former applications had caused the refrigerant flow through the tube to be in one direction only, the heat pump caused it to take place in one direction at one time and in the opposite direction at another, thereby taking advantage of the valuable reversible characteristic of the tube.

Because of this inherent reversible feature, the capillary tube eliminates the need for four valves, two expansion and two check, which are normally required in a heat pump system. The diagram for such a standard system is shown in Fig. 3. Differences between this system and the capillary system shown in Fig. 2 are quite apparent, indicating that the capillary tube would greatly simplify the heat pump system and should therefore be invaluable.

The application of capillary tubes to window units covered only a small range of operating temperatures since the unit would not be used for heating as outdoor freezing temperatures were approached. However, the heat pump developed in larger sizes required operation over a very wide range of temperatures, even to outdoor temperatures of 0 degrees F. and below. This demanded a new approach to the application of capillary tubes to heat pump systems, and required that the design limits of the capillary system be completely evaluated. By taking advantage of the benefits provided by the capillary system and minimizing the effect of its limitations, a simple, reliable heat pump system has been developed.

The greatest advantage of the capillary tube, of course, is its simplicity. It has no moving parts, and hence it is practically trouble-free. It cannot become a victim of wear, mechanical failure or variation in performance. Also it is inexpensive. As previously mentioned it is completely reversible without the aid of check valves or other operating parts. On the other hand, a capillary has only one ideal operating point. At load conditions, either above or below this design point, the performance of the system is affected. Although some means, such as the addition of an accumulator, have been found for reducing these effects, they still exist. Large variations cause a marked decrease in per-



Gerald L. Biehn, a native of Pennsylvania, received a B. S. in E. E. degree from Bucknell University in 1940 and served as a Westinghouse graduate student at Pittsburgh and E. Springfield and a period as junior engineer. From 1945 to 1950 he was laboratory supervisor at Hyde Park and from that date to the present, design engineer on heat pumps. During World War II (1st Lieutenant, Air Corps) he served as meteorologist and operations officer in the South Pacific area.

formance. Tubes used with the small capacity systems require special care both in manufacture and during installation into a system. They are also very susceptible to clogging during operation, although tubes for larger systems would not be nearly so critical. Another disadvantage of the capillary is the difficulty in arriving at the proper bore and length required for any particular system. Charging of capillary systems with refrigerant must be done carefully, for an exact amount is required to balance with the capillary length and the design operating condition.

Perhaps it should be mentioned at this point that some of the tubes for the larger systems should not technically be classified as capillary because their diameters are larger than those tubes normally considered to be in this category. Still, because of the manner in which they are used, it is felt that by identifying them as capillary tubes

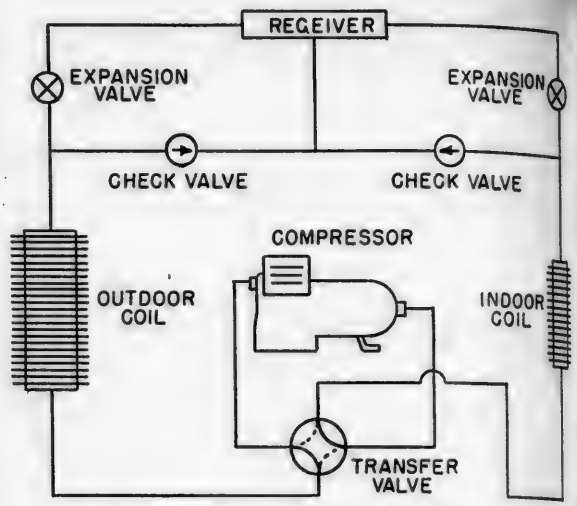


Fig. 3. Diagram of a normal heat pump cycle.

there can be no doubt as to their relationship to the rest of the refrigerant system.

In order to obtain actual data on the results of applying the capillary tube to an integral horsepower system, a development unit was built and instrumented to enable tests to be made over the complete operating range. A three horsepower unit was selected as a reasonable size for this

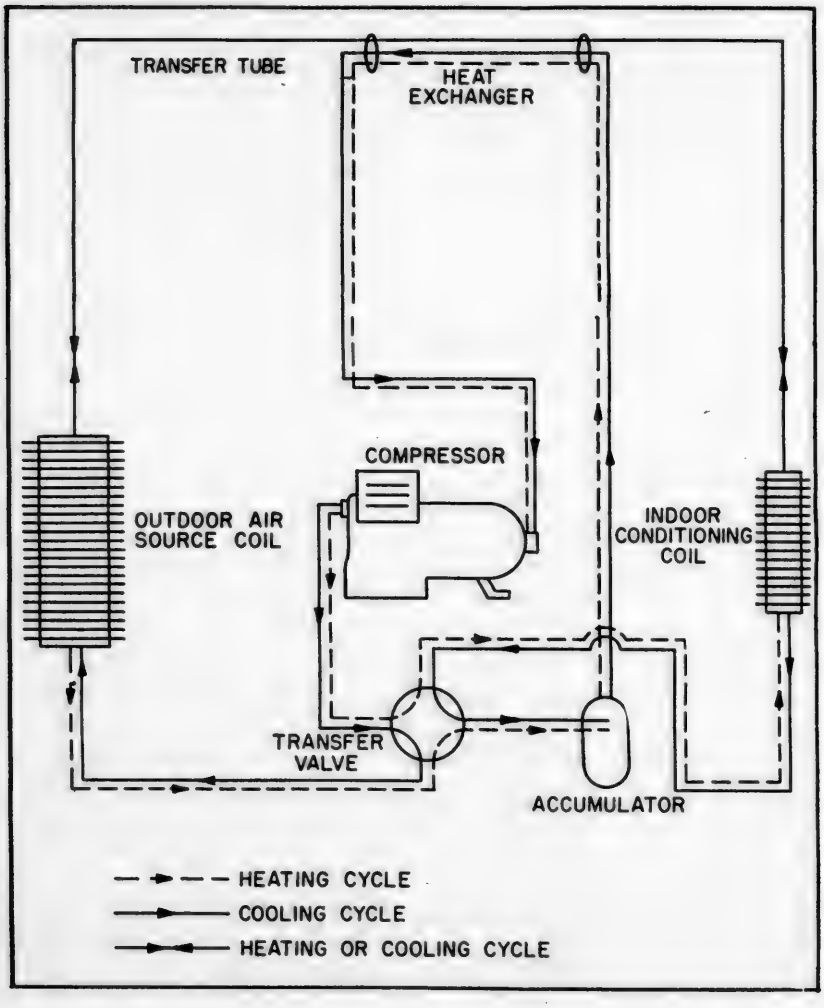


Fig. 2. Cycles of the heat pump window unit. Indicated are the heating cycle, cooling cycle, and the heating or cooling cycle.

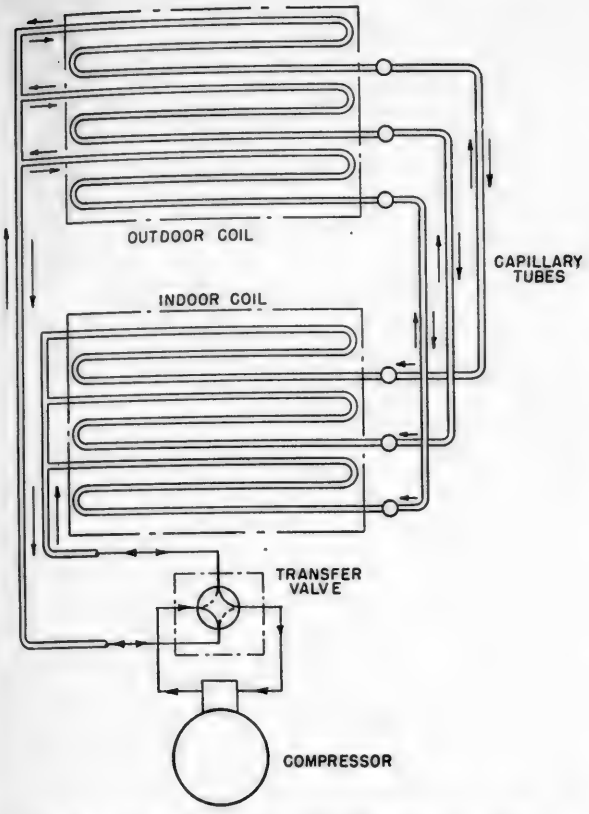


Fig. 4. Coil circuiting with multiple capillary tubes.

purpose. Using ASRE standard rating conditions as a basis, coil and capillary sizes were calculated. Because of previous experience with one ton capillary tubes, it was decided that both coils would be constructed with three separate circuits connected by three capillary tubes; that is, a circuit of one coil was connected through a capillary tube to a corresponding circuit of the other coil as shown in Fig. 4. Diameters and lengths of the capillary tubes were calculated by means of published capillary formulas.

More Refrigerant Required

After the unit was built and operating, it was found that more Freon was required during the cooling cycle than during the heating cycle. Even with an accumulator and a suction-to-liquid-line heat exchanger in the system, the average charge proved to be a slight overcharge at the lower heating conditions and an undercharge for best operation during the cooling cycle. In the course of our test program, various combinations of capillary lengths and charges were tried before an optimum pairing was reached, but the final combination was still a compromise because of the differences in the two cycles.

Originally the coils were built with individual vertical circuits, but by weaving these circuits through the rows of the coil a better balance of loading was obtained on each capillary. The effects of this circuit weaving were more pronounced on the indoor coil than on the outdoor. Typical circuiting of such a coil is shown in Fig. 5.

Since the results obtained from this unit were so promising, several other development units were built for more extensive testing and further experimentation. Three of these were 5 hp units basically similar to the original unit in design. Because of the increased capacity, however, five capillary tubes and five circuits per coil were provided. Several of the units were installed in residences in various sections of the country in order that their operation could be tested under actual field conditions. At the same time, development work was continued in the laboratory on the remaining units, largely with regard to improving capillary-coil relationship, and increase overall performance.

Refinements of Design

Two important refinements seemed to be required. The first was to provide a single capillary tube for each unit regardless of capacity. The second was to eliminate the necessity for compromise between the heating and cooling cycles, and to find a means of providing for more nearly ideal capillary conditions on both cycles.

The former was accomplished without too much difficulty by adding a distributor cluster of the type normally used with an expansion valve to each coil, and then replacing the parallel capillary tubes with a single one having a comparable effective length. This system is shown in Fig. 6. No noticeable variation in performance could be detected between the two methods, and the single tube not only is cheaper but also provides many assets from the standpoint of both manufacture and service.

Unfortunately, the latter problem of capillary balance between cycles was not so easily solved. Two approaches seemed to be open for finding a solution. One required a means of varying the charge between cycles, and the other a means of changing the effective capillary length. Of these the charge appeared easier to control, especially since one of the major features of the capillary tube was its complete reversibility. Subsequent investigation proved, however, that it was not really the amount of the charge but rather the position of the charge in the system which needed controlling. Too much charge was reaching the outdoor coil at the lower outdoor temperatures during the heating cycles, while at higher cooling loads the indoor coil was being starved. This meant that it was necessary to provide some simple means by which the restriction to flow would become greater in one direction than the other. Thus the advantage previously ascribed to the capillary by virtue of its constancy under given conditions, regardless of direction, was not perhaps as desirable as suspected.

Notes on Operation

Actually, of course, the conditions of operation are not identical over much of the heating and cooling ranges. Since the cooling cycle apparently required the shorter capillary and the larger charge, the first step was to operate the unit on the cooling cycle and adjust the capillary

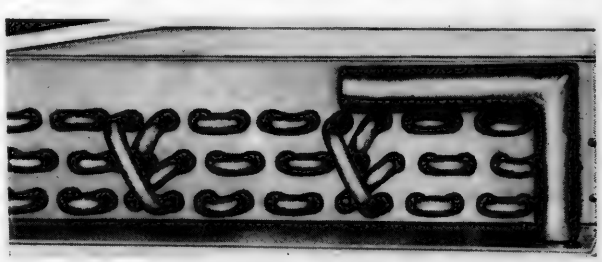


Fig. 5. Heat pump indoor coil showing balanced circuits.

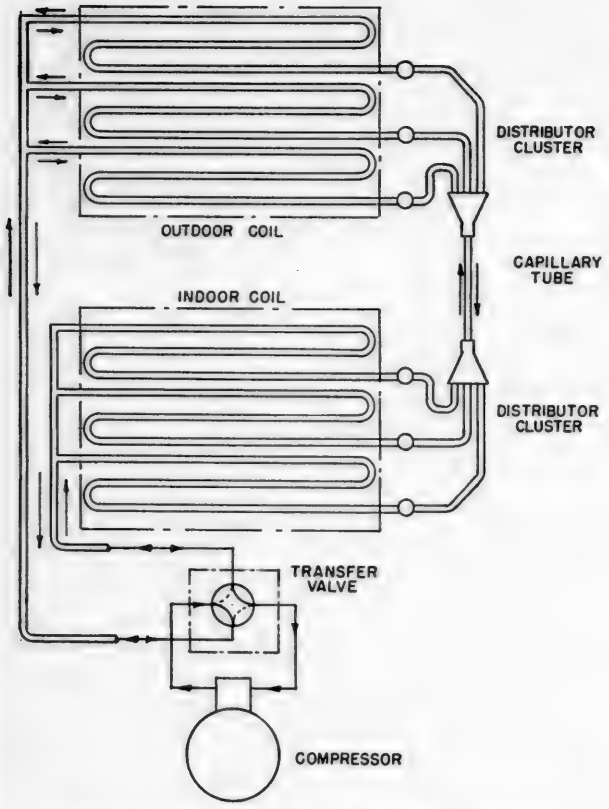


Fig. 6. Coil circuiting with distributor clusters and a single capillary tube.

tube and charge for best operation. A standard check valve was then added into the capillary just before it entered the indoor coil distributor so as to be open for cooling flow and closed for heating flow. Before placing it in the circuit a small hole was drilled through the valve disc. As the refrigerant flowed through this additional restriction the effective length of the capillary was increased for heating. By varying the hole size the capillary length could be adjusted to match the heating conditions and the charge. An improved variation of this control valve was developed and is shown in Fig. 7. Although the range of loading for

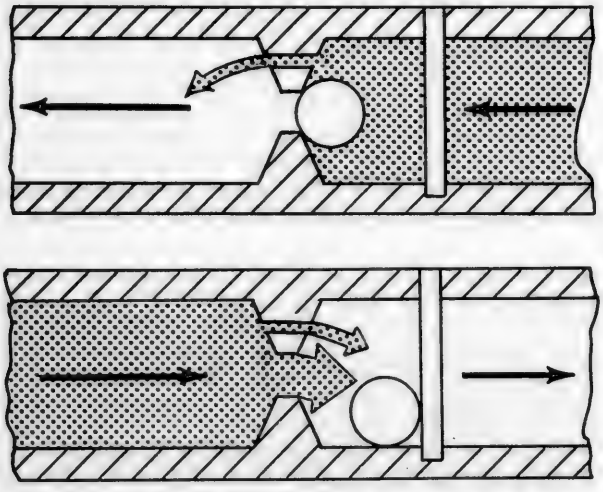


Fig. 7. Operation of capillary control valve; above, heating cycle and below, cooling cycle.

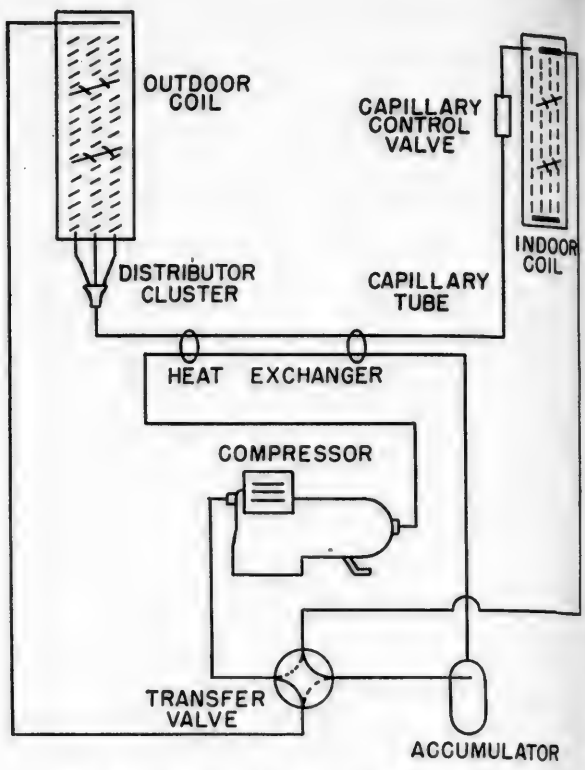


Fig. 8. Capillary tube heat pump cycle for integral horsepower systems.

the heating cycle is much greater than for the cooling cycle, it was found that by selecting the capillary length to match "ideally" at a mean outdoor temperature, it operated successfully over the entire range of expected outdoor conditions.

Going one step further, a row was added to the indoor coil to act as a subcooler during the heating cycle. This row held the excess charge which was prevented from flooding into the outdoor coil by means of the longer effective capillary and was now backed up into the condenser (indoor coil). The capillary tube was connected to this coil just beyond the control (check) valve. With this addition, the performance of the system was greatly improved.

Returning to the cooling cycle, this additional row on the indoor coil acted as a pre-evaporator. Although the distributor was at first kept in the system between the pre-evaporator and the original evaporator to obtain balanced flow in the multiple circuits of the coil, it was found that balanced loading of circuits could be obtained without using the distributor. This allowed for simplification and reduction of pressure drop.

The information obtained from field and laboratory development resulted in the simplified system shown in Fig. 8. The outstanding performance of this system conclusively shows that the capillary tube does provide a very real tool in heat pump design. This investigation was conducted with air to air heat pumps of the self-contained package types, and therefore the results apply to these alone. However, a similar system with minor modifications will operate as well with water or ground source units.

A capillary tube system provides simplicity and reliability that is difficult to achieve by other methods. The advantages are so marked that the next logical step is to extend the use to larger capacities.

Field Test of a Water-To-Air Heat Pump

S. L. PAPPAS*, F. R. O'BRIEN*, C. W. CHEATHAM**

A water-to-air heat pump installation in the office building of the Alabama Power Company at Phenix City, Alabama, was completely instrumented and tested for over a two-year period. The company conducted the tests and accumulated all the data on which this report is based.

A HEAT PUMP installed in the Alabama Power Company office building at Phenix City, Alabama is a production model, 10-hp, water-to-air heat pump which uses well water as its source of heat. A water pump driven by a 2-hp motor is installed in the 300-ft well that supplies the water requirements for the heat pump. The water is wasted into a sewer after use by the heat pump.

The building is one story and of brick veneer construction. A large show window in front faces south. The heat loss is calculated as 132,000 Btu per hr at 10 F outside and 72 F inside. The heat gain is 95,000 Btu per hr at design conditions of 95 F outside and 78 F inside temperature.

Instrumentation

Three cumulative kwh meters show energy consumption of the heat pump, water pump, and total service to the building (heat pump, lighting, etc.). Recording 15-minute integrated demand meters are also connected to each of the same loads. The water inlet and outlet temperatures are continuously recorded as are the inside air and outside air temperatures. A time meter showing the time of compressor operation in minutes is connected to the unit. A water meter indicates the water consumption in gallons.

All of these instruments are read daily (with the exception of week ends) at the same time of day. The temperature recording charts are changed weekly while the kw demand charts are changed monthly.

This heat pump operates continuously year-round under control of the room thermostat. This includes week ends, nights, etc. During the winter, the thermostat is lowered to about 65 F at night. During the summer the thermostat is maintained constant at about 78 F. Only during periodic maintenance inspections or breakdowns is the unit ever turned off.

The inside air fan operates continuously, including during the intermediate seasons of spring and fall.

Year Round Operation

Before analyzing seasonal operation, it may be well to look at operation over a complete year. Fig. 1 shows a monthly breakdown of total service and heat pump energy consumption. The total service and heat pump monthly load factors are also shown. Load factor is defined as:

$$\text{Load factor} = \frac{\text{(kwh energy used during period)}}{\text{(Maximum kw demand for period)} \times \text{(length of period in hrs.)}}$$

It can be seen from the above equation that the load factor represents the time percentage of use of an electric load, such as a heat pump, lights, etc.

It is obvious from Fig. 1 that the cooling energy consumption during the hottest months of the year is from three to four times the heating energy consumption dur-

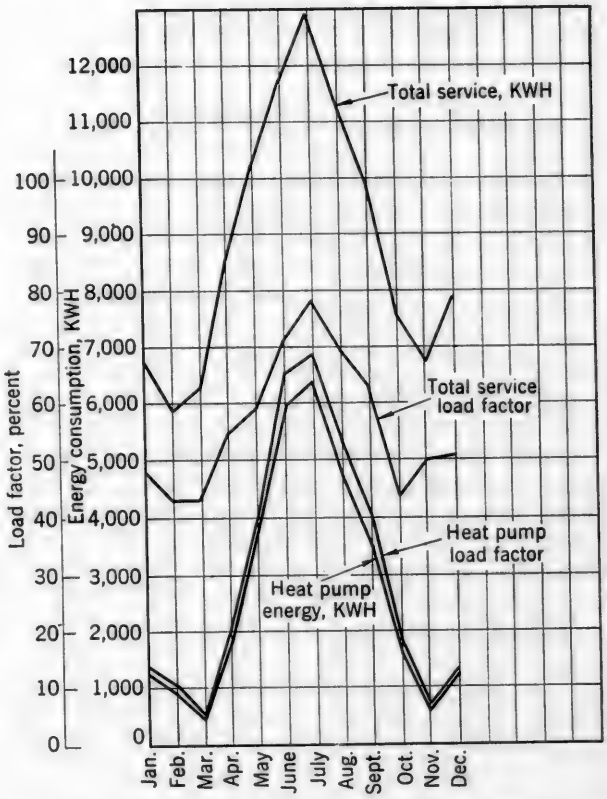


Fig. 1. Monthly energy consumption and load factors.

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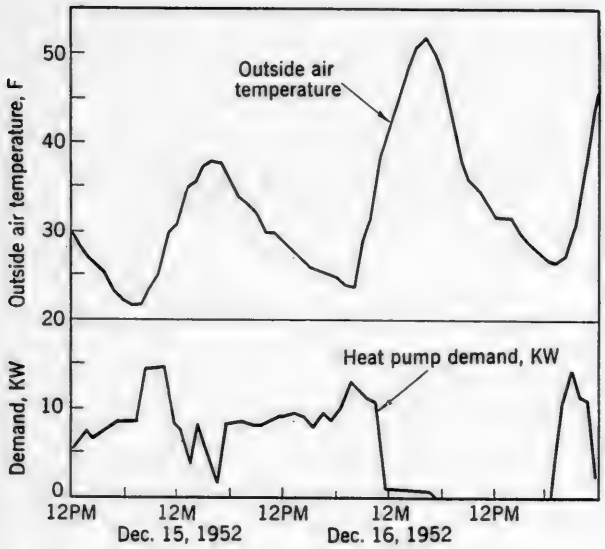


Fig. 2. Hourly heat pump demand and outside temperature.

ing the coldest months of the year. The same can be said about the heat pump load factor. It should be borne in mind, however, that the summer of operation shown here was one of the hottest ever recorded in the vicinity and the winter was extremely mild.

The almost parallel paths of the heat pump energy consumption curve and heat pump load factor curve are very obvious and appear to be in direct proportion.

The total service load factor does not seem to be affected as much by the seasons as the heat pump load factor. It follows the trend of the total service energy curve, however not as closely as in the previous case.

In view of the fact that the maximum demand in kw of the heat pump and that of the other electric load used in this building do not necessarily occur simultaneously, it is quite possible that the heat pump improves the total service load factor even though its own load factor is lower than that of the total service load.

Heating Season Operation

In order to show the effect that outside air temperature has on heat pump demand during the heating cycle, Fig. 2 has been developed for one of the coldest periods during the 1952-53 heating season. This is over a three day period in which the daily mean outside air temperature starts off low and increases gradually for the next two days.

It is seen from this figure that at the start of this period at midnight, December 14, the outside air temperature is 30 F and drops to 22 F in the early morning hours, remaining there from 6 to 8 a.m. The heat pump demand increases until a peak of about 15 kw is reached at about 10 or 11 a.m. There is a 2- to 3-hour lag between the lowest outside temperature and the maximum heat pump demand which appears to be a normal situation. The following day, December 16, 1952, a low temperature of 24 F occurred at 7 a.m., and the peak heat pump demand of 13.3 kw occurred almost simultaneously. On December 17, 1952, the lowest air temperature of 27 F occurred at 6 a.m. and the peak demand occurred 2 to 3 hours later.

It is interesting to note that from 11 a.m., December 16, to 6 a.m., December 17, the heat pump demand was practically nil. The solar heat gain during the day and the night set back of the thermostat may have been instrumental in keeping the demand down during this period. From this figure it appears that the maximum heat pump demand occurs in the morning hours between 7 to 11 a.m. The maximum demand for a residential installation would probably occur at an earlier hour.

Performance Factor

The performance of any heat pump on heating is evaluated by its coefficient of performance or C.O.P. as it is commonly called. The term C.O.P. represents an instantaneous value which is the ratio of the total heat output of the heat pump divided by the heat equivalent of the total electrical energy input. This is not a constant value and varies from time to time; consequently, an average C.O.P. is of much greater significance in evaluating the over-all performance of a heat pump. This average C.O.P. is called *performance factor* and can be calculated over any interval of time, such as an hour, day, month, or season

The heating seasonal performance factor for this installation was 2.4. The seasonal performance factor is an average of hourly, daily, or monthly performance factors that are greatly affected by the type of operation experienced by the heat pump. During short periods of operation, the performance factors are lowest; and during greater and sustained periods of operation they are highest. Thus a heat pump that operates for 5 minutes during one hour, and 35 minutes during another hour, has a higher performance factor during the latter period. Whenever a heat pump starts up, its C.O.P. is very low until it reaches a steady state condition of operation at which its C.O.P. is highest. The time required to reach this condition will vary from unit to unit depending on many variables.

Continuous operation of the inside air fan for ventilation purposes, as in this installation, will tend to lower the performance factor since the energy used by the fan is considered as part of the total energy input to the heat pump.

The performance of any heat pump on the cooling cycle is evaluated by its C.O.P. which is the ratio of the total heat extracted from the building divided by the heat equivalent of the total electrical energy input to the heat pump. This value of C.O.P. is generally lower than the heating C.O.P. value since the numerator of this equation does not include the heat of compression as it does on heating. As on the heating cycle, the performance

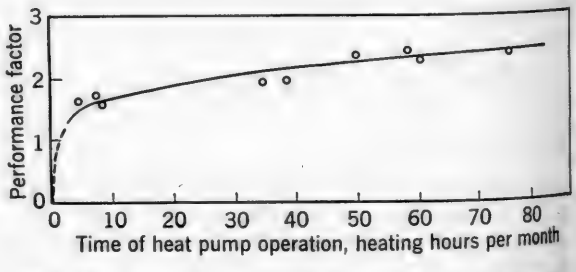


Fig. 3. Monthly performance factor vs. hours of heating operation per month.

factor of the cooling cycle represents an average C.O.P. for an hour, day, or season. The cooling seasonal performance factor for this heat pump installation was 1.6.

The performance factor of a heat pump can be used as an index of efficiency and has a definite relation to the cost of operation.

The decrease in the daily heating performance factor with a decrease in daily time of operation appears to be a straight line function from one to seven or more hours of daily operation. When the daily time of operation is less than one hour the performance factor begins to fall very rapidly and approaches zero. Thus, on extremely mild heating days it is obvious that the heat pump will operate at a very low efficiency. A daily operation of one hour or less represents many very small intervals of operation of only a few minutes since the thermostat in this installation has a very small temperature differential which makes it very sensitive.

Fig. 3 shows the variation of the monthly performance factor with the monthly hours of operation. The monthly performance factor is generally lower than peak daily performance factors, since it covers a longer period of operation which may include both cold and mild days. When the monthly hours of operation fall below 35, which means an average daily operation of of a little more than an hour, the performance factor of the heat pump begins to drop at a faster rate.

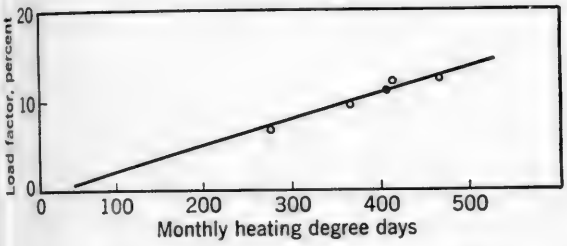


Fig. 4. Monthly heating load factor vs. degree days.

The relationship between monthly performance factor and monthly heating degree days appears to be a straight line relationship. As pointed out previously, the colder the weather the longer the heat pump operates, which means higher performance factors. The relationship between the heat pump load factor and heating degree days is shown in Fig. 4.

In Fig. 5 the average hourly heat loss during each month is plotted against the mean monthly temperature and appears as a dotted line from 72 F, where the heat loss is zero, to 10 F where the heat loss is 132,000 Btu per hr. Also shown in this figure is the average hourly heat output of the heat pump for each month against the average mean monthly temperature. The average hourly total heat output of the heat pump, lights, and related equipment for each month is also plotted against the average mean monthly temperature.

Theoretically, the average total heat output of the heat pump, lights, etc., should lie coincident with the heat loss line; however, this is not the case. The two lines are very close to each other and their slopes do not differ very much.

Above 62F the entire load on the building is carried by the lights and other equipment. The total heat output

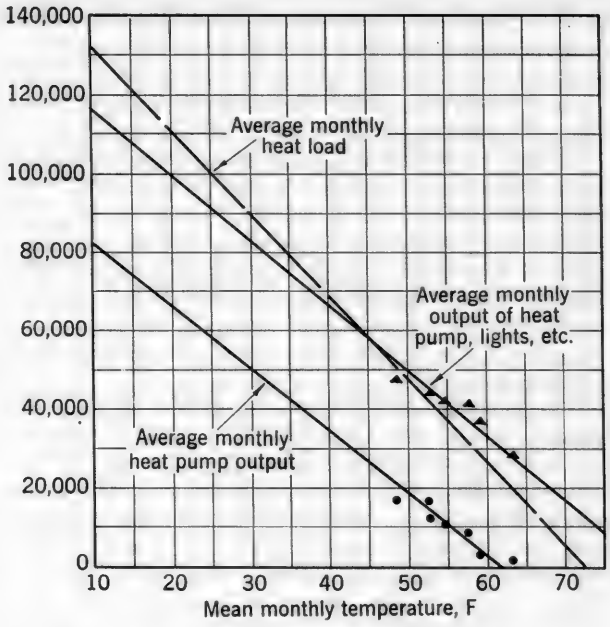


Fig. 5. Heat output vs. monthly mean temperature.

did not include the heat gain from solar energy, etc. It is obvious from Fig. 5 that about 30,000 Btu per hr are supplied to the building from sources other than the heat pump.

If the heat pump output curve is a straight line, as it appears to be, the output at 10F will be only 81,000 Btu per hr which is slightly more than half of the rated output of this size heat pump. It is apparent that this particular heat pump installation is over-sized and a smaller sized heat pump could do the job just as well and probably more efficiently.

This type of situation brings out the need to modify the present day heat loss method of sizing a heat pump or any other type of heating unit, by taking into account the lights and related electrical equipment that will be operated along with the heating system. The solar heat gain and the flywheel effect of the building or residence are other considerations that need to be taken into account in sizing. It was found that the energy required for pumping each gallon of water used increases with the hours of operation. Perhaps this is caused by the lowering of the water table which increases the pumping head. During long and sustained periods of operation the water table of some wells can be greatly affected depending on their rate of recovery. Variation of water temperatures can also affect the pumping energy requirements.

The energy consumption of the well water pump motor on the heating cycle was about 10% of the heat pump energy consumption on heating.

The total energy consumption of the heat pump and its auxiliary equipment on heating was about 16% of the total service energy consumption of the building during the heating season.

Cooling Season Operation

It is obvious from Fig. 1 that this heat pump worked a great deal more on cooling than it did on heating; however, as has been mentioned, the summer of 1952 was

one of the hottest ever experienced in Phenix City, Ala.

Records for June 25 show the effect of outside air temperature on heat pump demand for one of the hottest days of the 1952 summer. The lowest heat pump demand for this 24-hour period occurred at 7 a.m., about an hour after the minimum outside temperature, and the peak demand was distributed evenly from 1 p.m. to 10 p.m., while peak outside temperature occurred at 4 p.m. The heat lag in the building evidently caused the heat pump to operate well into the late night hours. The outside air temperature was above 100F between noon and 6 p.m. and was very slow in falling after the sun set. At 8 p.m. it was still above 90F and at 12 midnight had fallen to only 83F.

The monthly cooling performance factor, like the monthly heating factor, increases with an increase in the hours of operation. The monthly cooling performance factor falls very rapidly when the hours of operation are below about fifty per month. Since the cooling performance factor is always lower than the heating performance factor, the variation in performance factors is not quite as great on the cooling side as it is on heating.

The use of water on the cooling cycle per hp of total connected load per hour of cooling operation is more efficient over longer periods of operation as is the case on heating. As in heating, it takes more energy to pump water from the well when the periods of operation become longer. This again is probably due to lowering of the water table in the well.

The energy consumption of the water pump motor on cooling was about 15% of the heat pump cooling energy consumption. This percentage is larger than it was on heating; however, the increase in the pumping requirements due to a higher pumping head probably accounted for this.

The percentage of the total energy consumption of the building used by the heat pump and its auxiliaries during the cooling season was about 40%. This is a considerably larger percentage than it was on heating. A look at the considerably higher cooling season load factors as compared to the heating season load factors will bear this point out.

The extremely hot summer experienced by this heat pump installation may have caused the design heat gain of the building to have been surpassed a number of times. However, this heat pump handled the load very easily, since the unit is oversized.

Conclusions

It is obvious that some changes are necessary in the method of sizing heat pump installations if they are to operate with highest efficiency. It appears that, when conventional methods are used, a slightly under-sized job is better than an oversized job from the standpoint of both comfort and operating efficiency. When any heating or cooling system short cycles, the room air temperature fluctuates more than when the system is operating continuously under a fairly constant load. Intermittent operation can have a very adverse effect on the comfort of individuals, especially during the cooling cycle. A highly sensitive thermostat can correct this situation but at the expense of operating efficiency.

The cooling side of this heat pump was much better utilized than the heating side since the cooling load on the building was more nearly constant than the heating load.

The effect of lights and related equipment on the heating load can be substantial, especially in a commercial building. The cooling load will also be materially affected by this factor.

Longer operation of the heat pump means better utilization of the water supply and higher pumping costs.

Higher heating and cooling load factors can be achieved by decreasing the size of the heat pump.

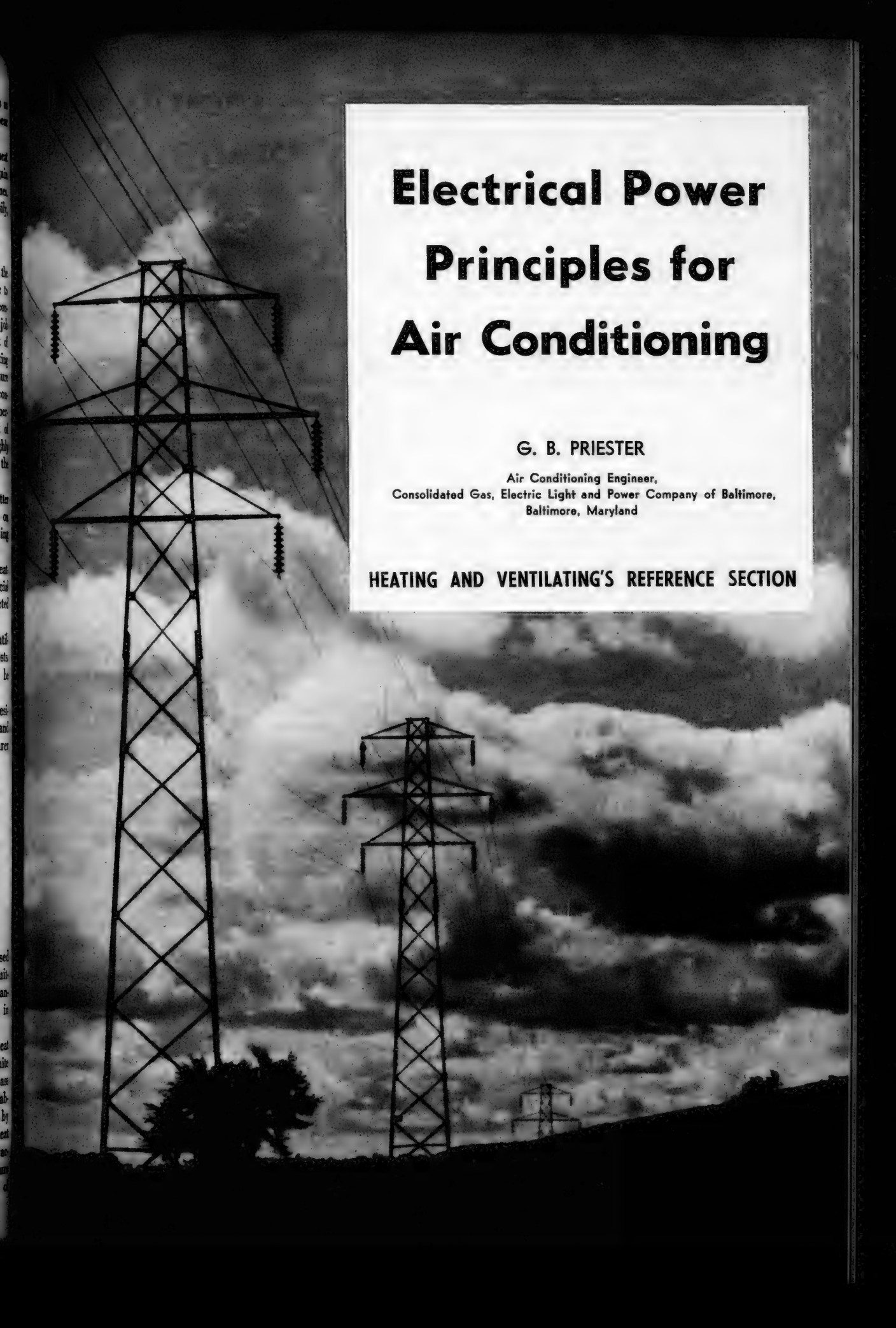
It is evident that similar tests are needed on both residential and commercial installations of both water and air heat source heat pumps in order to obtain a clearer and more concise picture of heat pump operation.

Summer Cooling Aided by Window Shading

A paper prepared at the Cleveland research laboratory of ASHVE by G. V. Parmelee, research associate, and D. J. Vild, research engineer, and presented at the semi-annual meeting summarizes the physical characteristics of slat-type shades and evaluates their effects on the reduction of heat gain. The authors stress the fact that comparisons of experimental results with heat gain values in current use indicate that reduction of heat gain with some shade and glass combinations is greater than anticipated in present design values.

This study was one of a series resulting from a long range research program in the effectiveness of slat-type sun shades. Previous studies dealing with the shading of sunlit glass included an experimental study of slat-type sun shades, an analysis of the effect of uniformly spaced flat opaque slats, etc. The present paper condensed previous experimental results and data to a form suitable for practical application in determining instantaneous heat gain from several types of flat glass in combination with venetian blinds and sun screens.

In conclusion the authors stated that the total heat gain with a heat absorbing glass and an indoor white shade is practically the same as for common window glass and a white shade. Compared with unshaded heat absorbing glass, the total gain is reduced about 10% by the use of a shade. They also emphasized that the heat gain values are instantaneous rates of heat gain. In practical situations, heat storage of the internal structure must be considered in determining the contribution of solar heat gains to cooling system load.



Electrical Power Principles for Air Conditioning

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HEATING AND VENTILATING'S REFERENCE SECTION

Electrical Power Principles for Air Conditioning

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With the increased use of air conditioning equipment, there has come about, in many cases, an overloading of the electrical wiring in buildings and new problems in electric power distribution. It has emphasized the need for a better understanding of electrical power principles to secure more satisfactory air conditioner installations and operation. This article covers basic electrical data for both commercial and residential applications.

GROWING realization and appreciation of the many advantages of air conditioning by the public have prompted numerous newcomers to enter the cooling equipment selling and installation fields, hoping to get "into the act" in time to benefit from this booming industry. But, like in any other business, there are many problems to meet and to overcome, often those related to electric power and its use have been slighted. It is the purpose of this article to present some of the fundamentals of electrical engineering which should be known in order to prevent trouble and to solve successfully some of the problems encountered when electrical energy is used for air conditioning.

First a quick review of electricity may be helpful. This should be easy for those who have studied physics, and we shall try to make it simple for the others. In order to know what we are talking about, let's start with a few definitions of electrical terms.

Definitions

Current is the rate at which electricity is being transferred in a circuit. It might be compared to the gpm flow in a hydraulic circuit. The unit of measure is the ampere; the symbol is *I*.

Voltage is the electromotive force (emf) which tends to produce a current in a circuit. It might be compared to the available pressure head in a hydraulic circuit. The unit of measure is the volt; the symbol is *E*.

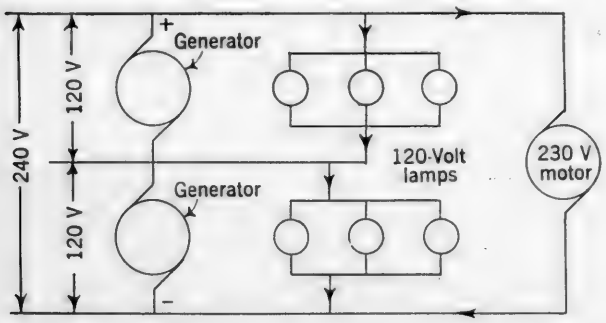

Fig. 1. Three-wire direct current service

Power is the rate of doing work in a circuit. The unit of measure is the watt or kilowatt (1,000 watts); the symbol is *P*.

Work is the total energy released in a circuit and is the product of power and time. The unit of measure is the kilowatt hour; the symbol is *W*.

In the practical application of electrical energy there are two different classes of phenomena, one related to continuous or direct current and the other related to alternating current. For this reason each type of current will be discussed separately.

Direct Current

In the early days of the electrical industry all generators were direct current and the current was distributed over relatively small urban areas where it is still found in a few of our large or older cities. Although most air conditioning contractors will not encounter direct current, brief information is given for those who will and as a general background for all.

A direct current is a continuous electric current flowing in one direction in a circuit with little or no change in its value. In such a circuit, the opposition to the flow of current is called *resistance*. This might be compared to the resistance or friction in a hydraulic circuit. The unit of measure is the ohm; the symbol is *R*.

According to Ohm's Law, the direct current *I* flowing through a circuit of resistance *R* varies with the applied potential *E* or

$$I \text{ amps} = E \text{ volts} / R \text{ ohms} \quad (1)$$

Transposing this equation, the voltage drop *E* across a resistance *R* varies as the current *I* flowing through it or

$$E \text{ volts} = I \text{ amps} \times R \text{ ohms} \quad (2)$$

The power expended in a direct current circuit is the product of the voltage *E* and the current *I* or

$$P \text{ watts} = E \text{ volts} \times I \text{ amps} \quad (3)$$

Since from (2), $E = IR$, power may also be expressed as

$$P \text{ watts} = (I \text{ amps})^2 \times R \text{ ohms} \qquad (4)$$

746 watts = 1 hp = 550 ft lb. Also 1 watt = 3.415 Btu per hour and 1 hp = 2,547.6 Btu per hour.

The work performed W is the product of the power P and the time t, or 1 kwhr = 3,415 Btu.

$$W \text{ kwhr} = P \text{ kw} \times t \text{ hr.} \qquad (5)$$

Since there are no satisfactory means of distributing direct current at the more economical higher voltages and then reducing it to the safer and more desirable utilization voltages, d-c generation, distribution, and utilization voltages are essentially the same. While 600-volt direct current is used to a limited extent in some industrial plants, the usual commercial d-c service supply is standardized at a nominal 120 and 240 volts. Most d-c motorized equipment is designed for 230 or for 115 volts, equipment of the latter design being limited largely to fractional horsepower motors. Motors are designed for slightly lower voltages than the nominal supply service to provide for a nominal voltage drop between the service entrance to the building and the motor location.

Direct current is usually distributed by a two-wire system having a single voltage or by a three-wire system having two voltages. Although a two-wire system is simple, it does not have much flexibility. Therefore, a three-wire system is more generally used, making power available at 240 volts across two lines and 120 volts from either of these lines to a grounded neutral line. Thus, 120-volt lamps which are more efficient and less expensive than 240-volt lamps can be used on the same system with 230-volt motors as shown in Fig. 1.

Alternating Current

An alternating current is a periodic oscillating current, the average value of which over the given time period vectorially is zero. Most electric air conditioning equipment is connected to an alternating current service although there are still a few localities where direct current is used. Alternating current generators, motors and other equipment have been developed which are less bulky, less expensive and less troublesome than direct current equipment, and alternating current can be transmitted greater distances much easier and more economically than direct current.

In alternating current circuits, Ohm's Law (referred to under Direct Current) ceases to hold due to the electromagnetic phenomena accompanying the continually changing current. The resistance R described under Direct Current ceases to be the determining factor of the current value, and Ohm's Law assumes the form

$$I = E / Z$$

where Z is the apparent resistance or impedance. The *impedance* consists of two components, one the effective resistance R and the other the reactance X.

$$Z = \sqrt{(R^2 + X^2)}$$

Where energy is expended only in heating the conductor, the resistance R in a-c circuits is the same as the resistance R in d-c circuits. In circuits where energy is also expended outside the conductor, due to the magnetic or inductive effects, R is larger than the true ohm resistance of the conductor since it refers to the total expenditure of energy. It is therefore called the *effective resistance* and may no longer be a constant for the circuit. The *reactance* X represents the surging of the energy to and fro. It is not a constant of the circuit but depends upon the current frequency. Hence, the effective resistance R is related to power, and the reactance X is related to the wattless or reactive component.

Frequency refers to the number of cycles that the voltage or current makes in a given time. A 60-cycle current means that a complete cycle of the flow of the current from the maximum positive value to the maximum negative value and back again occurs 60 times every second. The frequency of a system is kept constant by running the generator at a constant speed which for 60-cycle frequency is 3,600 rpm. Maintaining a constant frequency in a system makes possible the accurate operation of electric clocks since the frequency is continually checked against observatory time. Many of the large electric companies located near one another have interconnections which would mean that all the clocks operating in any such network are synchronized. In the early stages of a-c development, 25- or 50-cycle current, was

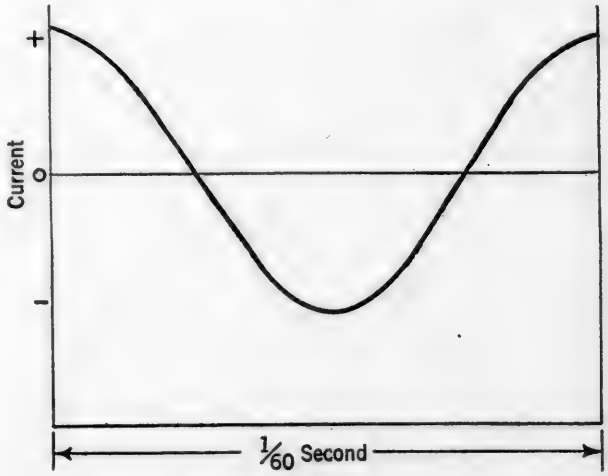

Fig. 2. Flow of 60-cycle single phase current

Mr. Priester, born in Minneapolis, Minn., received his B.M.E. with distinction in 1933 from the University of Minnesota. He was awarded a scholarship to Harvard University where he received an M.S. in Industrial Hygiene degree in 1934. He joined Carrier in 1935 and for six years served as application and sales engineer in New York City and Chicago. Mr. Priester then did consulting work and taught in the Mechanical Engineering Department at Case Institute of Technology where he received his M.E. degree in 1943. In 1946 he resigned as associate professor to take his present position of air conditioning engineer, Consolidated Gas Electric Light and Power Company of Baltimore.

He is co-author of the book Refrigeration and Air Conditioning; the author of several technical articles. He is past president of the Northern Ohio and Baltimore chapters of ASHVE, chairman of the Baltimore-Washington section of ASRE and editor-in-chief of the 1953-54 ASRE Data Book. Mr. Priester is a registered professional engineer.

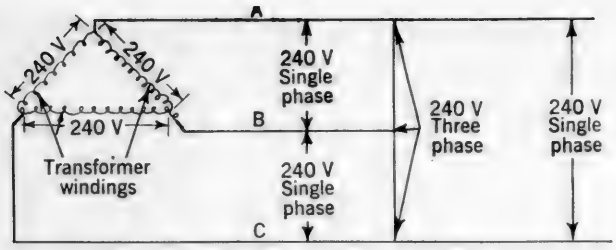

Fig. 3. Three-phase delta connections

used, but these frequencies have practically disappeared in our country, and 60-cycle has become the standard.

Phase of Current

In addition to frequency, another characteristic of alternating current is phase. Electric service is commonly referred to as single, two, or three-phase, with single phase supply using two or three wires, while two or three-phase supply uses three or four wires. With single phase two-wire supply, the maximum positive voltage occurs on one wire at the same instant that the maximum negative voltage is on the other wire. Then the voltage on each equally approaches zero until for an instant there is no voltage on either wire. This is followed by an increasing voltage in the opposite direction on each wire until the maximum is reached. The current flow in a single phase circuit varies in a manner similar to the voltage variations. A plot of voltage or current over a complete cycle every 1/60th of a second is shown in Fig. 2. The time of maximum current flow, however, may or may not coincide with the time of maximum voltage depending upon the nature of the circuit load.

A single phase system is one energized from a single electromotive force or voltage. A polyphase system is energized by two or more electromotive forces. The ordinary two-phase system (which is not very common and is found only in a few localities) is energized from two substantially equal voltages which differ in phase from each other by 90 electrical degrees or by a quarter of a cycle. A three-phase system is energized from three equal voltages which differ in phase from one another by 120 electrical degrees or one-third of a cycle.

In a three-phase supply, the individual transformer phase windings can be connected in either of two methods. One of these is known as a delta connection which is shown diagrammatically in Fig. 3. The other method is known as a star or Y connection, where a fourth or neutral wire can be run from the common connection as shown diagrammatically in Fig. 4. The voltage values in Figs. 3 and 4 represent nominal service voltages derived from the secondary windings of transformers when connected in delta and in star respectively. When connected star or Y, there results what is described as a 120/208-volt, three-phase, four-wire supply, normally used to supply a combined light and power load. In the latter instance, the 120-volt lighting and small motor load should be split so that approximately one-third of it is supplied between *A* phase wire and grounded neutral wire *N*, one-third between *B* and *N*, and the other one-third between *C* and *N*. Likewise the 208-volt single phase power load should be balanced with one-third between *A* and *B*, one-third between *B* and *C*, and one-third between *A* and *C*. A three-phase power load would be supplied from the phase wires *A*, *B* and *C* at 208 volts.

Supply Voltage

Alternating current power is generally transmitted at voltages varying from 2,400 to 240,000 volts, depending upon the distance and the load involved. High transmission voltages are used to keep energy losses to a minimum and to permit the use of reasonable size wire conductors. Transformers are used to step down the higher voltage so that power is made available to customers at a safer utilization voltage. Note that transformers are for a-c only and are more simple and less expensive than motor-generator sets which are required for changing a d-c supply voltage.

There are several types of alternating current secondary supply services available, depending upon the specific location. The most common types are tabulated in Table 1. The 480-volt supply service is often used when heavy loads such as large motor driven centrifugal refrigerating compressors are located at some distance from the meter or electric service entrance location in the building. In a few localities, 240-volt, two-phase, 3-wire or 240-volt, two-phase, 4-wire service is available. The great bulk of air conditioning equipment, however, is designed and shipped from the factory for use on one or two of the electric service characteristics listed in Table 1.

In the downtown areas of many of our large cities a so-called a-c network system of distribution is used, which is furnished power from more than one source. Wires are generally run underground usually in ducts owned by the city. Since transformer space is at a premium, a combination power and light or 120/208-volt, three-phase, 4-wire service is usually used. In areas outside such network districts separate single phase and three-phase delta systems are generally used.

A disadvantage of the 208-volt, three-phase, 4-wire system is that unless large size copper conductors in close proximity to one another and within limited distances from the transformers can be used, such as are possible in the underground a-c network system, the starting of motors on the system can cause objectionable light flickering and troublesome operation of other equipment or appliances.

Before connecting any motor, control device, or electrical equipment to any service, the name plate should be checked to note the voltage and type of current which can be used. Manufacturers and shippers should provide adequate instructions with each electricity-consuming unit. These instructions should be followed carefully regarding where each of the electric service wires is to be connected, particularly for dual voltage equipment. Guessing or taking a chance on this can cause a serious accident or trouble.

Power and Power Factor

From the preceding sections it should be evident that

TABLE 1—COMMON TYPES OF ALTERNATING CURRENT SUPPLY

Volts	Cycles	Phases	No. of Wires
480	60	3	3
240	60	3	3
240	60	1	3
208	60	3	4
120	60	1	2

the current, voltage, resistance, and power relationships for d-c circuits do not always apply to a-c circuits. The power in a single phase alternating current circuit is generally less than the product of the voltage *E* and the current *I* due to the existance of reactance.

The product *EI* in a single phase circuit, therefore, is called the apparent power and is expressed in volt-amperes or kilovolt-amperes. The true power must be obtained by a watt meter or by some other means. The ratio of the true power in watts over the apparent power in volt-amperes for any specific load is called the *power factor* for that particular load. In a single phase circuit the power factor equals $P/(EI)$, while in a three-phase circuit the power factor equals $P/(\sqrt{3}EI)$.

The power factor is usually expressed as a percentage and is, for example, 100% for straight resistance loads such as heating and lighting and less than 100% for loads containing reactive components such as motors. For a given amount of power, the lower the power factor, the higher will be the current. The higher current caused by the low power factor requires increased generator, transmission, and distribution capacity. All of this increases the cost of supplying electric service without increasing the energy consumption or the revenue to the power company. Furthermore. a low lagging power factor resulting from an inductive load causes an excessive voltage drop in distribution lines. It is beneficial, therefore, for all concerned to have electric loads with as high a power factor as possible. A power factor may be lagging or leading, depending upon whether the time the maximum current occurs is after or ahead of the time of maximum voltage.

Most a-c motors are of the induction type and draw a lagging current, causing a lagging power factor. Synchronous motors may be operated to produce a unity or even a leading power factor and thus, can be used to correct a lagging power factor in a system. Synchronous motors, however, are not practical, except for comparatively large constant speed loads.

The power factor of induction type motors decreases as the loading of the motor decreases and therefore, it is desirable that motors be selected so that they will be well loaded when used.

A summary of alternating current relationships is given in Table 2.

Electromagnetism

The question may arise as to why does alternating current produce such different effects than direct current. The answer lies in the application of the principles of electromagnetism. Whenever a current flows through a conductor such as a wire, a magnetic field is produced around this wire. If you are looking down a wire and the current is flowing away from you, the magnetic field will be clockwise around the wire. If the current is flowing toward you, the magnetic field will be counterclockwise. This magnetic field may not be of great significance for a single straight wire, but if the wire is arranged in the form of a coil, an appreciable magnetomotive force can be generated, which produces a magnetic flux or force in the core of the coil. The value of this force is proportional to both the number of turns of wire and the current flowing in the wire.

TABLE 2—ALTERNATING CURRENT UNIT RELATIONSHIPS

$I = E/Z$ $\quad$ $E = I\,Z$

$Z = \sqrt{R^2 + X^2}$ $\quad$ $R = P/I^2$

For single phase	For three phase
$p.f. = P/(E\,I)$	$p.f. = P/(\sqrt{3}\,E\,I)$
$W = p.f. \times E\,I\,t/1{,}000$	$W = p.f. \times \sqrt{3}\,E\,I\,t/1{,}000$

I = amps current per line
Z = ohms circuit impedance
X = ohms reactance
p.f. = power factor
t = hours time
E = volts potential
R = ohms effective resistance
P = watts power
W = kwhr work

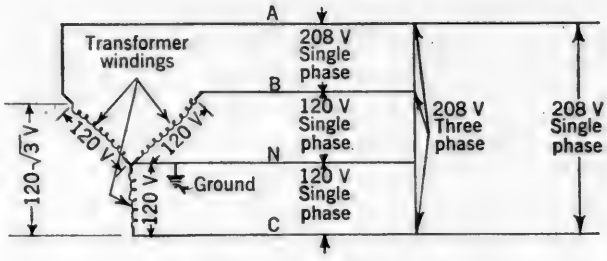

Fig. 4. Three-phase Y connections

Faraday discovered experimentally that whenever there is a change in the magnetic field surrounding a conductor, a difference in electric potential is induced in the conductor. This principle is applied in the design of generators, motors and transformers. A difference in electric potential may be produced by

(1) Moving the conductor across a stationary magnetic field, such as in d-c generators.
(2) Exposing the conductor to a moving magnetic field such as in a-c generators, or
(3) Changing the current in a stationary conductor surrounded by a magnetic circuit such as in spark coils, induction coils, and transformers.

When d-c or a-c flows through a long wire in the form of a single loop with the two sides close together, the magnetic field established is comparatively weak. Even the electric potential self-induced due to the changing a-c current is practically negligible. The voltage required to cause a given current to flow would be only that needed to overcome the electrical resistance of the wire. In such an application, the formulas for circuits as given under Direct Current would apply.

If this same length of wire were wound around a core to form a coil, the magnetic field strength could be of significant value, varying directly as the number of turns of wire and as the amount of current. If a constant value d-c is flowing through the coiled wire, there is no induced voltage. When the value of current changes, however, such as on opening or closing the circuit, a voltage tending to oppose the change in current will be induced in the coil as stated in item 3. This principle is utilized with the spark coil, breaker points, spark plugs, etc. in the ignition system of an automobile.

If a-c is run through the coiled wire, the current will have a zero value twice a cycle or 120 times a second. This induces an electric potential of an appreciable amount which will vary with the strength of the magnetic field established. Additional voltage must be impressed on the circuit to overcome this self-induced electric potential if the same flow of current or power is desired.

The electromagnetic principles previously described may be put to use to operate valves, switches, chucks, and lift-

TABLE 3—APPROXIMATE FULL-LOAD MOTOR CURRENT IN AMPERES

HP	Single Phase		Three Phase		Direct Current	
	115V	230V	220V	208V	115V	230V
1/6	3.2	1.6				
¼	4.6	2.3				
½	7.4	3.7	2.0	2.1	4.6	2.3
¾	10.2	5.1	2.8	3.0	6.6	3.3
1	13.0	6.5	3.5	3.7	8.6	4.3
1½	18.4	9.2	5.0	5.3	12.6	6.3
2	24	12	6.5	6.9	16.4	8.2
3	34	17	9.0	9.5	24	12
5	56	28	15	15.9	40	20
7½	80	40	22	23.3	58	29
10	100	50	27	28.6	76	38

Current values at other voltages are inversely proportional to the voltage.

TABLE 4—CONDUCTOR SIZES AND OVERCURRENT PROTECTION FOR MOTORS

Full Load Current Amperes	Minimum Size No., Conductors in Raceways	Maximum Ampere Rating of Non-adjustable Protective Device
1	14	2
2	14	3
3	14	4
4	14	6
5	14	8
6	14	8
7	14	10
8	14	10
9	14	12
10	14	15
12	14	15
13	12	20
16	12	20
17	10	25
20	10	25
22	10	30
24	10	30
26	8	35
28	8	35
30	8	40
32	8	40
34	6	45
36	6	45
38	6	50

ing magnets. Most substances, including most metals, are non-magnetic, but iron and steel are magnetic. If the core of a coil of wire consists of iron or steel, the core becomes magnetized and can then attract another piece of iron or steel.

Solenoid Valves

A solenoid valve usually consists of a vertical coil wound around the outside of an insulated vertical cylinder. When the coil is energized, the magnetic force generated will draw a steel plunger up into the center of the cylinder, and in so doing can open a valve. When the power is cut off, the plunger drops by gravity and closes the valve. In some a-c solenoid valves a hum develops or the plunger vibrates and chatters, and the usual remedy is then to replace the valve.

These valves are used quite extensively in direct expansion cooling systems where they are usually operated by the cooling thermostat or by an auxiliary switch on the coil face and bypass damper motor if such is used. They usually are wired so that whenever the air conditioning fan stops, the current to the valve is cut off so refrigerant cannot flow into the cooling coil to flood it and possibly cause liquid refrigerant to be drawn back to the compressor.

Motor Running Currents

The approximate normal full load running currents of standard motors are given in Table 3, and the minimum size wire or conductor in raceways as listed in the 1953 National Electrical Code is given in Table 4. It is noted from these tables that the maximum size 115-volt single phase motor which can be connected to a 15-ampere (size 14 wires) circuit is ¾ hp.

Motors for 240-volt service are usually name plated 230 or 220 volts. The voltage at the motor terminals is less than at the electric meter due to the voltage drop in the conductors from the meter to the motor. Likewise, motors for 120-volt service are sometimes name plated 110 or 115 volts. Motors for 208-volt service, however, should have a name plate voltage of 208 volts or less. In other words, the name plate voltage rating should not be higher nor much lower either than the service voltage. Although motors are usually designed to operate at rated voltage, plus or minus 10 per cent, the motor name plate voltage should be close to the nominal supply service voltage less an allowable votage drop in the wiring from the service entrance for the building to the motor location.

Motor Starting Currents

When a motor is started at full voltage, the instantaneous current drawn from the line is limited only by the impedance of the motor winding. This instantaneous inrush of current when the motor is at a standstill is called its locked-rotor or starting current. It is from five to seven times the motor's rated full load running current and occurs whenever the motor starts, whether under a load or not. The only difference in starting a loaded motor versus an unloaded one is the length of time it takes for the motor to accelerate and the current to drop back to the running value after the start.

When a motor is supplied from a transformer, a secondary service, and customer wiring, all sized for a normal load, the high value starting current of the motor causes an excessive voltage drop in this secondary service. When a lighting load is also supplied from this same service, the sudden voltage drop is often sufficient to cause an objectionable flicker in the lights.

TABLE 5—APPROXIMATE MINIMUM FULL LOAD EFFICIENCY AND POWER FACTOR PER CENT VALUES FOR A-C MOTORS AT 1,800 RPM.

HP	Single Phase General Purpose Split Phase		Single Phase Capacitor		Three Phase Induction	
	Eff.	p.f.	Eff.	p.f.	Eff.	p.f.
⅛	53	52				
1/6	58	56	63	57		
¼	62	60	68	62		
⅓	63	61	70	63		
½	65	63	72	64		
¾	67	65	73	65		
1					75	79
1½					78	82
2					80	84
3					81	86
5					83	87
7½					85	88

Motor Power and Fan Power

With reference to input and output of motors, the following equations apply:

kw input = hp output × 0.746/motor efficiency

For single phase a-c motors:

hp output = E I × p.f. × motor efficiency/746

For three phase a-c motors:

hp output = $\sqrt{3}$ E I × p.f. × motor efficiency/746

where *I* is the average current for the three separate phases.

or, full load amps =

rated hp × 746/($\sqrt{3}$ E × p.f. × eff.)

Approximate minimum full load power factor and efficiency values for motors at 1,800 rpm are shown in Table 5. Although the motor efficiency may not drop appreciably from 100 per cent to 50 per cent of full load, the power factor may drop about 10 per cent and even more for small size motors.

With reference to motors for fans, the fundamental fan law that for a given system handling air at a given density, the fan power requirements vary as the cube of the fan speed or air quantity delivered, should be remembered. In other words, if it is desired to have a given air handling system deliver 25 per cent more air, the required fan speed will be 1.25 times the original speed and the fan power required will be $(1.25)^3$ or 1.95 times the original power. It might be possible that a larger motor would be needed to meet this increased air requirement.

A summary of these motor power and fan laws is given in Table 6.

TABLE 6—MOTOR POWER AND FAN LAWS

For motors

kw input = hp output × 0.746/motor efficiency

For single phase motors

hp output = E I × p.f. × motor efficiency/746

For three-phase motors

hp output = $\sqrt{3}$ E I × p.f. × motor efficiency/746

where I is the average of the current values for each phase

full load amps = rated hp × 746/($\sqrt{3}$ E × p.f. × eff.)

For a given fan system and given air density:

Air flow varies directly as the fan speed.

Power required varies as the cube of the fan speed.

Services for Residential Air Conditioning

While most residential areas receive their electrical energy from 2,400/4,160-volt, three-phase, 4-wire, Y-connected primary utility distribution systems, individual residential services are normally supplied from one of the three 2,400-volt phases through transformers which step the voltage down to a utilization service of 120 and 240 volts, 3-wire, single phase. In many instances, therefore, only 2,400-volt, single phase, 2-wire primary service is readily available in the vicinity of a residence and the supply of three-phase service might involve considerable expense.

Generally speaking then, residential single phase service is usually supplied from one phase of a 2,400/4,160-volt, three-phase, 4-wire *primary* distribution system which makes available, 2,400-volt, single phase, 2-wire *primary* service. A transformer steps this down to a combination 120 and 240-volt service in the *secondary, main, or bus.* A given secondary may serve several customers supplying 120/240-volt, 3-wire or 120-volt, 2-wire service. The wires running to each house from a pole carrying the secondary service are called the *service loop* or *drop.*

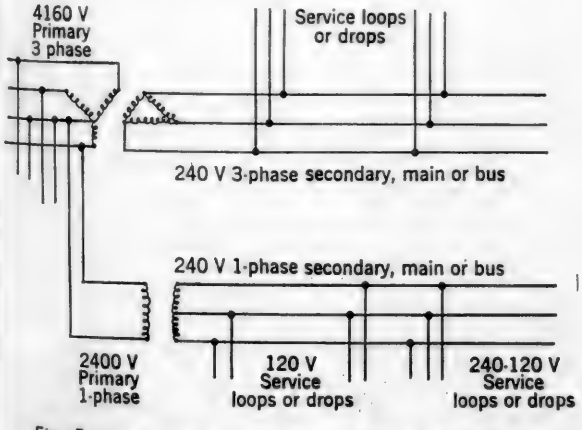

Fig. 5. One form of residential electric distribution

In some cases, due to the size of a proposed motor installation, the magnitude of its starting current, and the location on the utility company's distribution system, it might be necessary to supply three-phase service. It is then desirable to extend the three-phase, 4-wire *primary* distibution system and install transformers to step it down to 240-volt, three-phase, 3-wire service which is carried in the *secondary, main,* or *bus* wires. This secondary may also serve more than one customer, and the three wires running to each house from a pole carrying the secondary service are also called the *service loop* or *drop.* This is diagramed in Fig. 5.

The question of which type of service is best for residential customers with air conditioning equipment is controversial, but in general, depends upon each specific location on a given system. Furnishing single phase service for motors of 3 hp and larger often presents the problem of strengthening the existing service to reduce the complaints of light flickering caused by the starting of each motor. Also, single phase motors of 3 hp and larger are not as satisfactory as three-phase motors. Furnishing both single and three-phase services means attaching six wires to a house, and the wires must be spaced so that the wind cannot cause any two of them to come close enough to each other to create a short circuit, should the insulated covering deteriorate. In many instances the cost of extending three-phase service to reach the customers might be expensive. Furnishing a combination four-wire service provides both single and three phase power but has the disadvantage given in a previous section.

Fig. 6 shows a pole and transformer with the 2,400/4,160-volt, three-phase, 4-wire primary service on top of the cross arm at the right and a 2-wire street lighting service at the left. The 120/240-volt, single phase, 3-wire secondary service from the transformer is shown on the side bracket and running toward adjoining poles on each side. Four 120-volt, 2-wire service loops or drops are shown running toward houses on the right. The lower wires are for telephone company equipment.

New Electric Service

As our standard of living increases with more time-saving, labor-saving, and pleasure-giving appliances be-

Fig. 6. From this transformer pole in a residential area, it is possible to obtain a 2-wire service loop and also a 3-wire loop

coming available to more people, the electric load per residence increases. As a result, in many localities now a 240-volt, single phase, 3-wire service is required for each new house or whenever a new circuit is run in an existing house which has only 120-volt, 2-wire service. When 240-volt service is available, it is strongly recommended that all motors of at least ¾ hp or larger be purchased for and connected to the 240-volt supply. A separate special 240-volt circuit should be run to such a motor or motors, however. Whenever a 240-volt circuit is run, a special receptacle should always be employed so that only a special pronged plug can be used and the common two pronged plug used on 120-volt appliances can not in any conceivable way be used.

If a house now has only 120-volt, 2-wire service and 240-volt, 3-wire service is required, the electric utility in most localities will supply the 3-wire service loop or drop to a bracket attached to a side of the building without charge. The customer must then run new conduit containing the three wires from this point of attachment outside the house to the meter and then to his new main switch, usually located inside the house. The utility company will replace and install the new electric meter normally without charge. The customer must have an electrician run the new conduit and he must purchase and install the new fused switch, plus any circuit wiring needed in the house. The 240-volt service is usually required if there is more than one air conditioning unit in the house or if any unit in the house has one or more 1 hp (in some cases ¾ hp) motors in it.

Fig. 7 illustrates a 120-volt, 2-wire service loop or drop to one residence and a 120/240-volt, 3-wire service loop or drop to the adjoining residence. Generally speaking, air conditioning in the residence on the right is limited to a maximum of one small room cooler without changing the electric service.

Residential Electric Circuits

When most of the small houses were built in the past, they were supplied with a 120-volt, single phase, 2-wire, a-c service. Inside the house there usually were four or six separately fused circuits for the lights and the appliance receptacles. A separately fused circuit was usually run to the heating plant if it had a motor-driven fan, water circulating pump, oil burner, or coal stoker. It has generally been recommended, and in many places also required, that a home freezer also be put on a separately fused circuit.

In an effort to give the customer good service and to reduce possible fire hazards, many electric utilities do not permit the installation of motors of ½ hp or larger on 120-volt circuits. Exceptions have been made, however, in the case of room air conditioners under certain conditions in various localities. In many communities, electric supply service conditions are such as to permit manually controlled ½ hp units and also manually controlled ¾ hp units on 120-volt circuits, provided the locked-rotor current or instantaneous maximum starting current is not over 40 amperes plus an individual testing tolerance of 15 per cent, and provided certain other local utility regulations are met.

The National Electrical Code, which is the standard of the National Board of Fire Underwriters states that "Individual branch circuits may supply any loads. Branch circuits having two or more outlets may supply only loads as follows: 15 and 20 ampere branch circuits, lighting units and/or appliances: The rating of any one portable appliance shall not exceed 80 per cent of the branch circuit rating. The total rating of fixed appliances shall not exceed 50 per cent of the branch circuit rating if lighting units or portable appliances are also supplied."

A 15-ampere circuit uses at least size 14 wires and a 15-ampere overcurrent protective device (fuse or fusetron). A 20-ampere circuit uses at least size 12 wires and a 20-ampere overcurrent protective device to safeguard the circuit.

According to these regulations, if a room air conditioner is considered a portable appliance, it may then be served from a 15-ampere branch circuit having other receptacles if its full load current does not exceed 80 per cent of 15 or 12 amps. (such as 115-volt ½ hp units which draw from 7 to 10 amps). Likewise, it may be served from a 20-ampere branch circuit having other receptacles, if its full load current is not over 80 per cent of 20 or 16 amperes (needed for 115-volt ¾ hp units which draw from 13 to 16 amps). The total load on the circuit, of course, should not exceed the circuit rating. If there are no other receptacles, the circuit rating should still be at least 125 per cent of the full load current. A unit wired for and connected to 240-volt service, of course, would have a current half of that for a unit of the same size on 120-volt service.

Whenever the blowing of properly sized fuses is experienced, the electric current rating of the appliances used on the circuit and the loading of the circuit should be checked. If the circuit is overloaded, a new circuit should be run or the load reduced. A fuse rated larger than the circuit rating such as a 20 ampere fuse with a size 14 wire circuit should not be used. If the circuit is not overloaded and the fuse blows on starting the appliance, a fusetron might be used instead. This device will permit overcurrents for short duration such as due to motor starting, but will not

allow sustained overcurrents and will protect against a short circuit.

Suggested Precautions

In order to avoid trouble and possibly save money, it is recommended that:

(1) Each air conditioning contractor study a copy of or acquaint himself with the Electric Service Rules of the electric utility which serves his territory.

(2) Notify the proper person at the electric utility company in sufficient time, unless advised otherwise by the electric utility representative:

(a) Whenever a motor of ½ hp or larger is to be installed on a 120-volt circuit.

(b) Whenever a motor of 1 hp or larger is to be installed on a 240- or 208-volt single phase circuit.

(c) Whenever a three-phase motor is to be installed.

(3) Find out the locked-rotor or starting current rating of each motor and the approximate number of times each motor will start per day, then learn from the electric utility company whether each motor can be started across-the-line or whether a reduced voltage starter or other device is needed at the particular installation location.

(4) Check the exact voltage and type of service available at the installation location. If the service is 208 volts, order only motors whose name plates indicate they are suitable for use on 208 volts.

(5) Use only motors designed and tested for the electric service available. A 220- or 230-volt motor on 208 volts service often causes trouble and definitely is not recommended.

Cooperation Needed

The equipment manufacturers, the local sales and installation people, and the electric utility company representatives must all work together so that this fast growing air conditioning industry can help raise our standard of living in the most desirable manner.

If the residential air conditioning electric load continues to grow at the present rate, it may soon be necessary to require that air conditioning equipment operate at a much higher power factor than is obtained from the present room cooling units and small central residential air conditioning systems. Those concerned should get together now and make plans to meet this increasingly serious problem of low power factor.

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(15) Motors and Their Control, Chapter 27, *Air Conditoning Refrigerating Data Book—Design 1953-54.* The American Society of Refrigerating Engineers, New York.

Fig. 7. Rear view of residences to show 2-wire and 3-wire residential service connections

LONDON LETTER

Commentary on developments in Europe by our correspondent in Great Britain

IN science and technology the greatest opportunities for progress lie not in the perfection of known techniques but in the borderlands between them. How far is this true? Is it true at all? Has the amateur anything to teach the professional who knows his job? Probably not, in the ordinary way. But every so often the germ of an idea is born when an expert in one field applies his knowledge to another. Give a botanist, for instance, the job of designing a humidity control valve, and he may produce something that no engineer would have thought of, yet which works and is proof against current failure.

Dr-Ing. R. Pris recently gave a paper in Paris to the A.I.C.V.F. (Association of French Heating and Ventilating Engineers) on the applications of aerodynamics to the heating and ventilating of buildings, and this has been published in the Association's Bulletin* (**30**, *6*, 12 and *7*, 12) The author does not waste any time on achieving satisfactory ventilation by means of a fan or other mechanical device. That is too easy, and too expensive. He sets out to show what information is available, and how it can be applied, with respect to ventilation by natural means. Natural dynamic ventilation arises from the action of the wind. Natural thermal ventilation occurs when there is a difference between the external and internal temperatures, such as in a building equipped with central heating. A combustion appliance such as a heating stove may also produce a ventilating effect by reason of its demands for combustion air, and this he calls forced thermal ventilation.

In recent years the designers of aircraft have learned a great deal about the effects of wind on surfaces, and some of this can be applied in ventilation. However, the wind-tunnel constructed in France by Eiffel in 1910 is still in use, helping to solve problems such as that of the design of the roof of a new steel works over some Bessemer converters. It was desired to make the best possible use of thermal ventilation to evacuate the fumes and dust, and a model on a scale of 1:125 was made, and tested in the wind-tunnel.

The author draws upon the work of several countries and uses some 60 diagrams and graphs which help to simplify his admittedly complex subject. Investigations of the external and internal pressures caused by the wind have been made in France, Denmark, Belgium and Germany, and the Danish work is quoted from in some detail; the positive and negative pressure coefficients outside and inside buildings of different shapes are given together with small graphs showing the distribution of such pressures on surfaces not symmetrically placed, such as side walls. There is also reference to the work done with helium in Britain about four years ago, showing that in an exposed windy site dynamic ventilation can be more important than thermal, but at wind speeds below about five miles per hour, thermal effects predominate.

*Chauffage, Ventilation, Conditionnement. 19, Rue Blanche, Paris IX.

Thermal Ventilation

In quite a simple case, such as a single story building divided into four rooms, the calculation of the effect of wind from a stated direction upon the air changes between the rooms can involve 12 equations for the four unknown room pressures and the eight unknown air flows from each room to the outside and from room to room. Thermal ventilation does not lead to the same degree of mathematical complication, and it is often the case that one effect is sufficiently important for the other to be neglected by comparison. However, chimneys that will not draw when the wind is in a certain direction are known to most heating engineers, and at least three of the 16 chimneys of your correspondent's house can never have been any use since they were constructed 70 years ago. Dr. Pris shows clearly what one has to beware of in the matter of putting boiler houses and their chimneys near other buildings, for example, and he explains how the reduced pressure inside the boiler house, due to the wind, may nullify the thermal pull of the chimney.

The Model Expert and Ventilation

Another case in which models were used to solve a ventilating problem was reported from Switzerland a short time ago by H. Schellenburg (H. & L.† **50**, *4*, 124). He gave as an example the shower room in the new welfare wing of a Swiss factory. The shower baths were arranged in open cubicles and the ceiling was fairly low. Ventilation was to be provided by supplying fresh air at ceiling height at one end drawing air off at the same level at the opposite end. Existing knowledge does not provide a means of forecasting whether the ventilation in the cubicles will be satisfactory. Building the complete job and trying it out can be an expensive procedure if one has guessed wrong. Although much is known about the best ways of installing and controlling a chosen ventilating system, there is still much guesswork in the actual choice, says the model expert. It is not sufficient to specify merely so many air-changes per hour. The question of air-change efficiency in all parts of the occupied space must be considered.

By using models, together with some method of making the air-flow visible and photographing the result, the

†Schweizerischer Blatte fur Heizung and Luftung, Stadelhoferstr. 23, Zurich, Switzerland.

right choice of air-distribution arrangements can be made economically. The technique was apparently successful in the case of the shower cubicles, and in two other cases quoted: one of these was the operating theatre of a hospital with the air inlet and outlet at the centre of the ceiling; the other a lecture-room with air inlets all down one side and exhaust outlets along one end. But we are not told how to use models. There is no indication of scale, nor how to allow for such things as change of temperature with height. Interpreting the results of model experiments is claimed to be a job for the expert in this art. It is noteworthy that most of the research in airflow patterns in the U. S. A. is done on full scale.

The Gas Turbine Expert and the Heat Pump

There are perhaps two ways of setting up a team of men. One can recruit persons skilled in different techniques, and wait for them to begin to understand one another. Or one can take on a staff of people who speak the same technical language and get down to work at once.

When the Ministry of Fuel and Power created a new department and appointed Dr. Roxbee Cox (formerly Director of the National Gas Turbine Establishment) as Chief Scientist, he chose the second way. So when the Chief Scientist's Department was asked to undertake the design and installation of a large heat pump to heat the Royal Festival Hall, the engineers who tackled the job brought a good knowledge of aircraft engines and gas turbines to their task.

Three days before Christmas P. E. Montagnon and A. L. Ruckley told the Institute of Fuel all about it, and their paper will shortly be published in the Institute's Journal. It begins with a quote from James Thurber: "I brought to the enterprise a magnificent ignorance of the workings of a gas engine and a profound disinterest in its oily secrets." It is believed over here that this may be the largest heat pump in the world today, and despite the facts that it includes an internal combustion engine, a centrifugal compressor for Freon, and such a gross over-estimate of the heating needs of the Festival Hall that it cannot be run for more than an hour or so at a time, some technical details will be of interest.

It was decided that the Royal Festival Hall was to be heated by a hot water system with gas-fired boilers, and in his contribution to the discussion on the paper the engineer responsible for the Hall said he was very glad he went right ahead and put them in. The heat requirements were estimated at a peak of 25 million Btu per hour, and this estimate was defended on the grounds that the Hall is not finished yet and there has been no really cold weather during the last two years; however, the heat requirements have not exceeded about half the 9 million Btu per hour for which the heat pump was designed and which was expected to enable it to run on base load. The extensive sound insulation inside the Hall, which is a great achievement, complicated the heat loss calculations.

It was thought that, whereas a heat pump could not compete economically with solid fuel, it might be able to do so with gas. To make the comparison more direct, gas-fired prime movers were used for the compressors; these were Merlin aircraft engines running at around 2,500 rpm and driving rotary compressors at speeds up to 20,000 rpm. These take up less than half the space that would be required by slow-speed gas engines driving reciprocating compressors.

The architectural design of the Hall called for minimum heating surfaces and a hot water temperature rather higher than was desirable for a heat pump, in fact up to 180 deg F for peak demand. A two-stage pump was therefore developed, drawing its heat from the Thames at 41 deg and heating up to 155 deg water returned from the building at 125 deg. The Freon-12 is supplied to the condenser from the second stage compressor at 186 deg and 246 psia at a flow rate of 26.6 lb per sec. It leaves the condenser at 130 deg in liquid form, and is expanded in two stages. In the first stage the pressure is reduced to 115 psia and this is followed by a separator in which the flash vapor (17½% of the total flow) short circuits to the inlet of the second stage compressor. The remaining liquid, 22 lb per sec at design conditions, is expanded to 45 psia and 32 deg and passed through the evaporator which is warmed by Father Thames. The first stage compressor pumps the resulting vapor up to 113.5 psia and 113.5 deg, and after mixing with flash from the separator the second stage compressor is entered at 113 psia and 110 deg.

The water from the building at 125 deg goes first through a liquid cooler to undercool the Freon from the condenser, then through the condenser itself, which it leaves at 145 deg and a flow rate of 29,000 imperial gallons* per hour. A branch is taken off for engine cooling, and when this has rejoined the main stream the temperature has gone up by 5 deg. A final 5 deg boost to 155 deg is gained from a waste heat boiler through which the engine exhaust gases flow.

Rotary compressors are tricky things. They "surge" if the mass flow is not in suitable relation to the speed and pressure ratio. For any given compressor this relation needs to be found by test. Matching two compressors in series as to flow, speed and pressure ratio is even more difficult. Although with electric drive it might have been possible to develop automatic control, the heat pump with the gas engines needs a skilled full-time attendant.

The overall efficiency from heat in gas to heat supplied to the Hall was 125%. The coefficient of performance in the more usual terms of useful heat output divided by power supplied to compressors and circulating water pumps is between 2.5 and 3.0; one contributor to the discussion divided the 57 therms per hr transferred to the water in the condenser by the 16 therms per hr which is the useful output of the two engines working at 320 brake horsepower each, and said the coefficient of performance was nearer 3.5. The heat pump was installed some distance away from the Hall, under the arches of Hungerford Bridge, and the water for the evaporator had to be pumped from mid-Thames; the auxiliary power requirements were therefore considered to be excessive.

Even so, it would appear that a heat pump can only justify itself in the British climate if it is so small in relation to the heat requirements that it can have a load factor of at least 25%. If it is justifiable to install refrigeration for the few days in the year when summer cooling is desirable, then the heat pump size should be based on the cooling load, and the additional heat supplied by cheaper equipment.

*1 imperial gallon = 10 pounds of water.

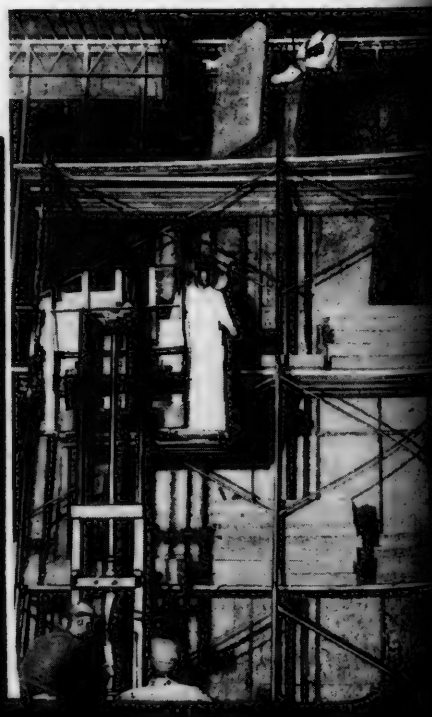
(Above) To prevent snow and rain interference with plant routine, Grumman Aircraft Engineering Co. embeds A. M. Byers' snow melting coils of wrought iron pipe in concrete apron of tracks serving sliding doors of hangars. Hot water and anti-freeze will circulate through coils.

(Above) New portable Chrysler 75,000-watt auxiliary generator, mounted on truck, is powered by 180-hp Chrysler V-8 Industrial engine. Generator uses little more than 25 per cent of capacity output to power 600 bulbs, 300 ft of neon tubing and 4 searchlights with total of 104,000,000 candlepower.

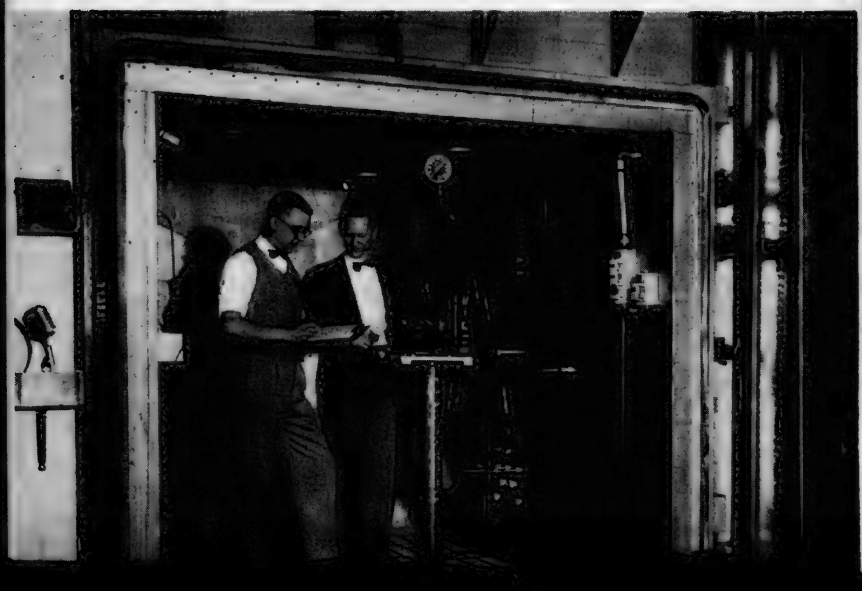
(Right) Main entrance to the functional Ford assembly plant in St. Louis, designed by Albert Kahn Associated Architects and Engineers. This project, erected in 1946, was recently awarded a silver medal by the American Institute of Architects' St. Louis chapter.

Picture Paragraphs

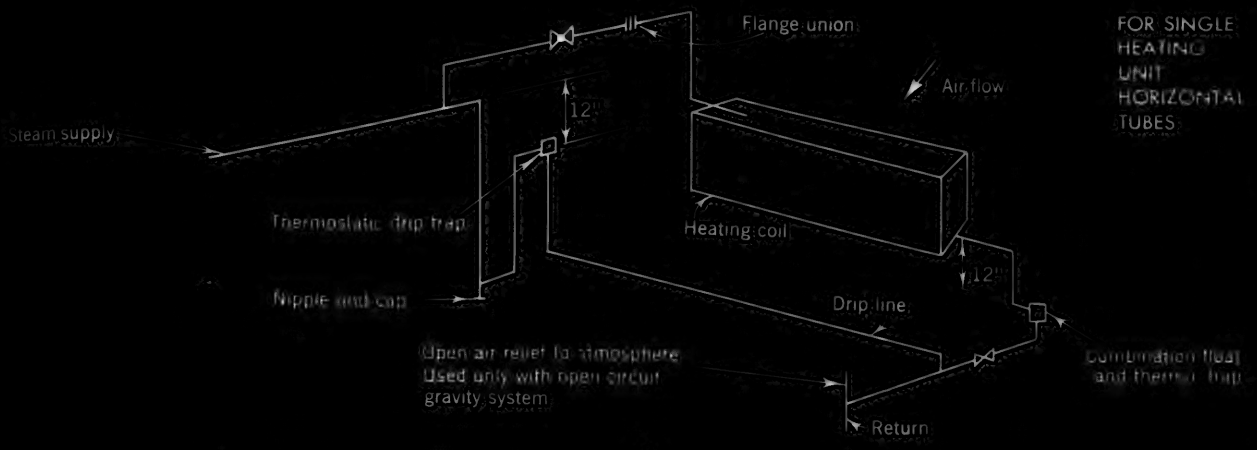
(Below) Fiberglas insulation being applied to wall of huge new Pasco Packing Co. warehouse in Florida. Temperature of —15 F will be held in 2.5 million cu ft.



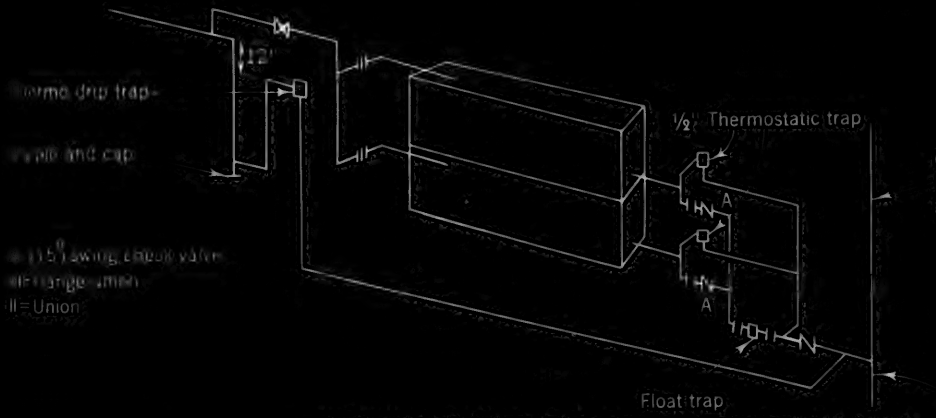
(Below) Guardite hot-cold box at Walter Kidde's laboratory in Belleville, N. J., creates temperatures from —100 F to +300 F, humidities from 20% to 95% and equivalent altitudes to 82,000 ft for aircraft equipment testing.



PIPING FOR HEATING COILS
IN OPEN CIRCUIT GRAVITY OR VACUUM SYSTEMS

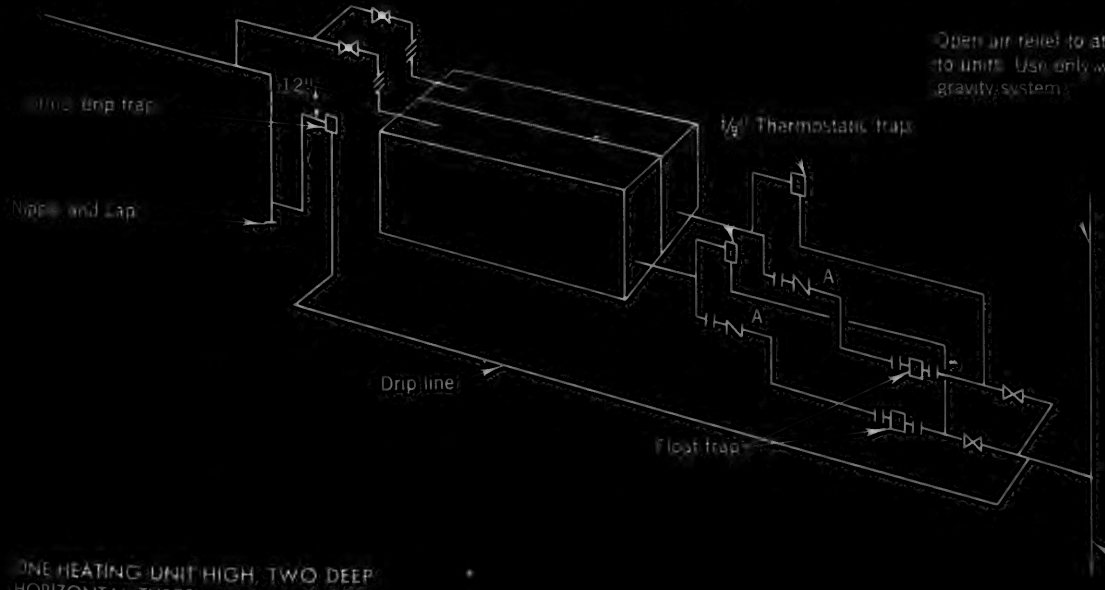


FOR SINGLE HEATING UNIT HORIZONTAL TUBES



Open air relief to atmosphere close to units. Use only with open circuit gravity system

TWO HEATING UNITS, ONE UNIT DEEP HORIZONTAL TUBES

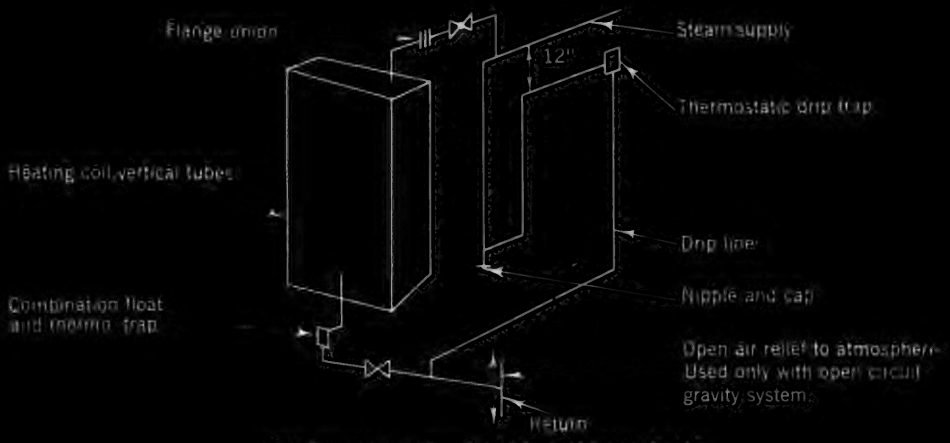


Open air relief to atmosphere close to units. Use only with open circuit gravity system

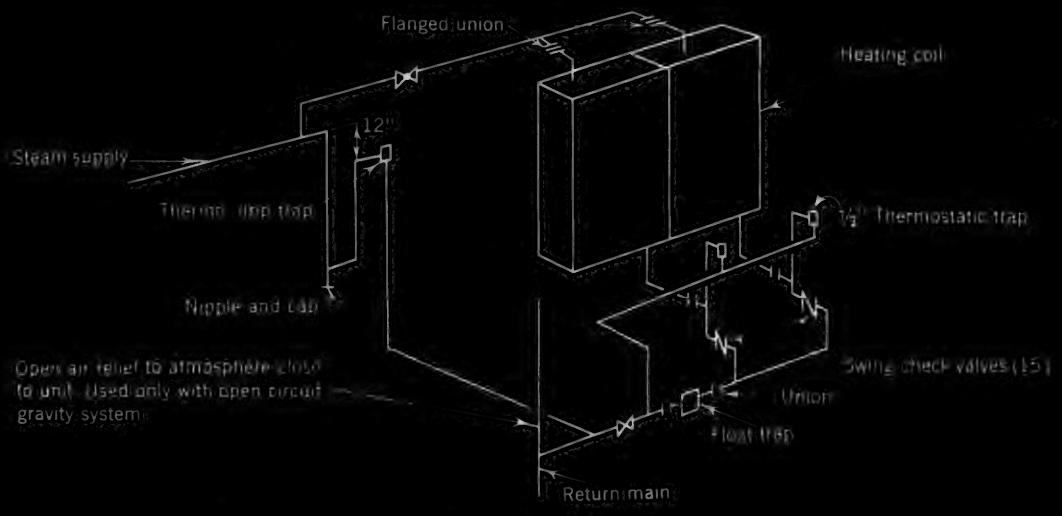
ONE HEATING UNIT HIGH, TWO DEEP HORIZONTAL TUBES

HEATING AND VENTILATING'S DETAIL SHEET

PIPING FOR HEATING COILS
IN OPEN CIRCUIT GRAVITY OR VACUUM SYSTEMS



FOR SINGLE HEATING UNIT - VERTICAL TUBES



TWO HEATING UNITS, ONE UNIT DEEP - VERTICAL TUBES

THESE PIPING DIAGRAMS, WHICH ARE FOR STEAM PRESSURES BELOW 20 LB.
ARE MADE POSSIBLE THROUGH THE COOPERATION OF
AEROFIN CORP., SYRACUSE, N.Y.

Insolation on Cloudless Days

at the Time of Solstices and Equinoxes

I. F. HAND

U. S. Weather Bureau, Blue Hill Observatory, Milton, Mass.

Charts are presented to show the daily hourly values of insolation on various surfaces at the time of the solstices and equinoxes over continental United States—specifically for latitudes 25°, 30°, 35°, 40°, 45°, and 50° North. It is a continuation of an article by Mr. Hand in the January, 1950 issue of HEATING AND VENTILATING.

A graphic presentation of the diurnal march of insolation received on several surfaces at the time of the solstices, June 21 and December 21, and the equinoxes, March 21 and September 21, is given in Figures 1 to 18, inclusive. The calculations were made for average clear sky conditions, and application of the data for local conditions must take into account the degree of atmospheric contamination, humidity, and elevation above sea

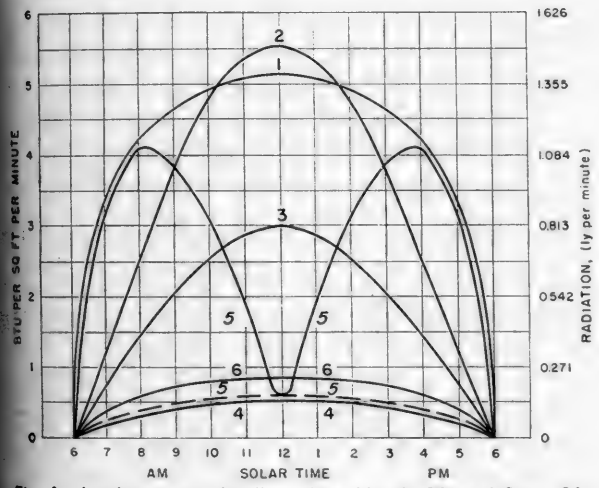


Fig. 1. Insolation on cloudless days March 21 and Sept. 21, for latitude 25°N.

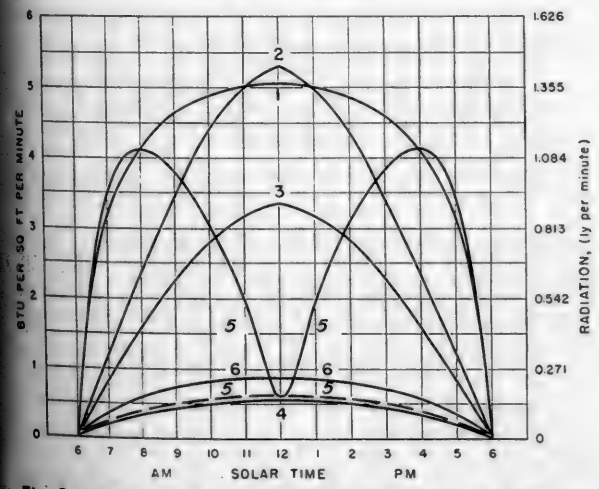


Fig. 2. Insolation on cloudless days March 21 and Sept. 21, for latitude 30°N.

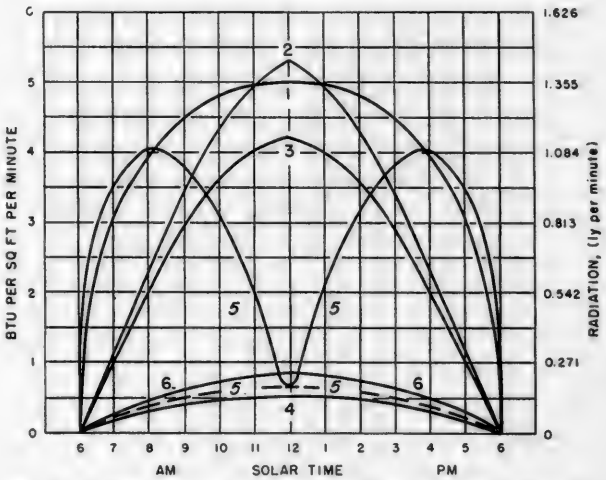


Fig. 3. Insolation on cloudless days March 21 and Sept. 21, for latitude 35°N.

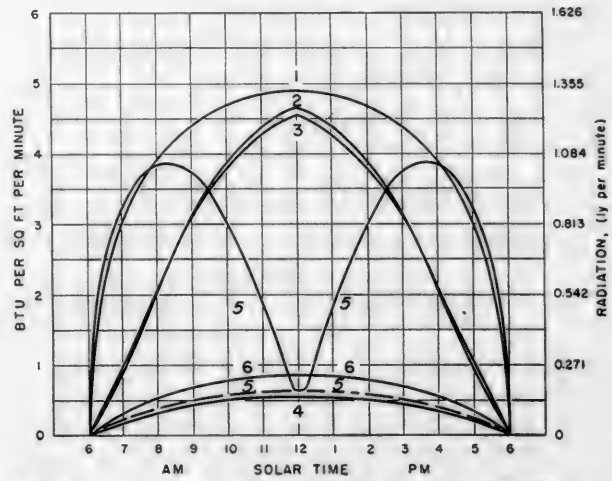


Fig. 4. Insolation on cloudless days, March 21 and Sept. 21, for latitude 40°N.

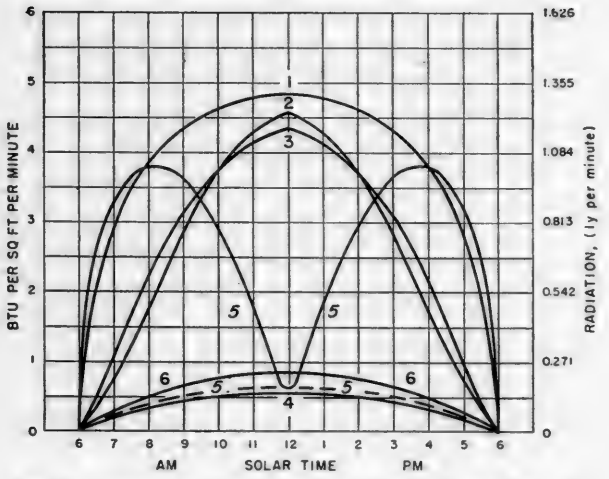


Fig. 5. Insolation on cloudless days, March 21 and Sept. 21, for latitude 45°N.

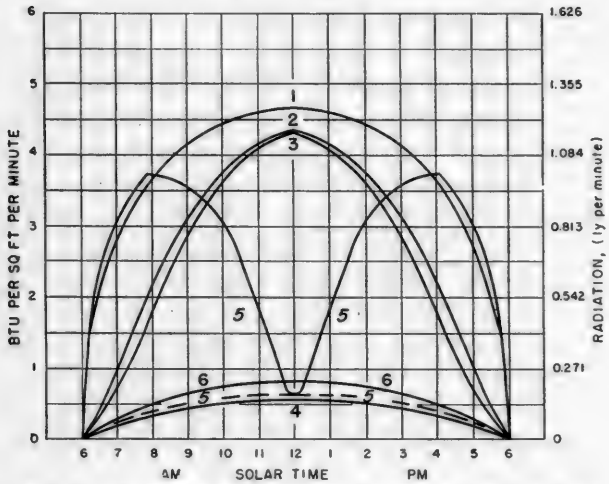


Fig. 6. Insolation on cloudless days, March 21 and Sept. 21, for latitude 50°N.

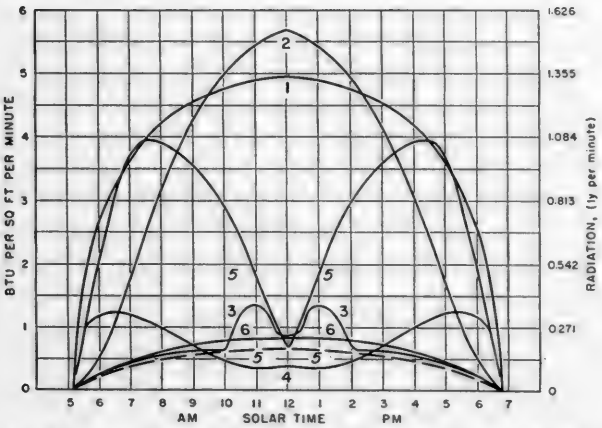


Fig. 7. Insolation on cloudless days, June 21, for latitude 25°N.

level. For example, values of total insolation in large industrial cities might be 20% lower than here given, while we would expect considerably higher values of total solar energy at high elevations, as for example, Estes Park and Grand Lake, Colorado.

These variations would be reversed in the case of the

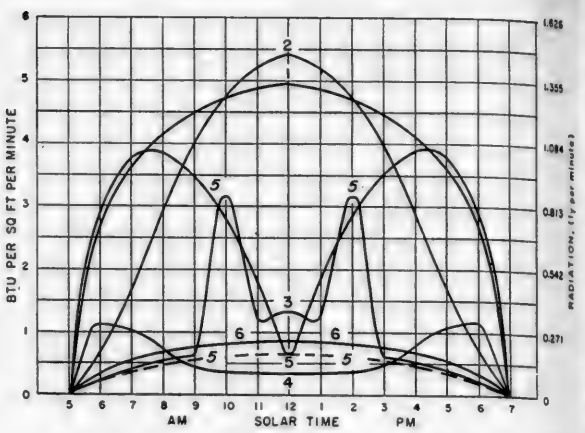


Fig. 8. Insolation on cloudless days, June 21, for latitude 30°N.

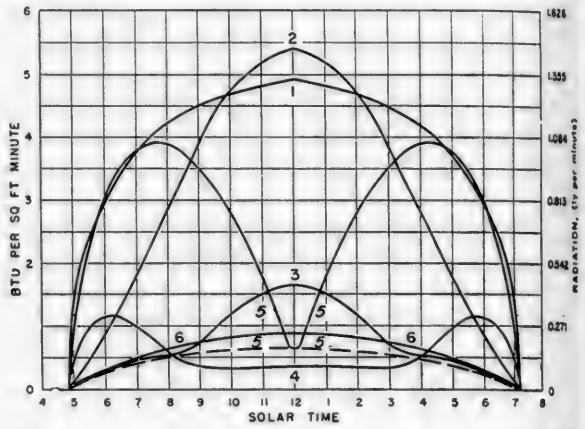


Fig. 9. Insolation on cloudless days, June 21, for latitude 35°N.

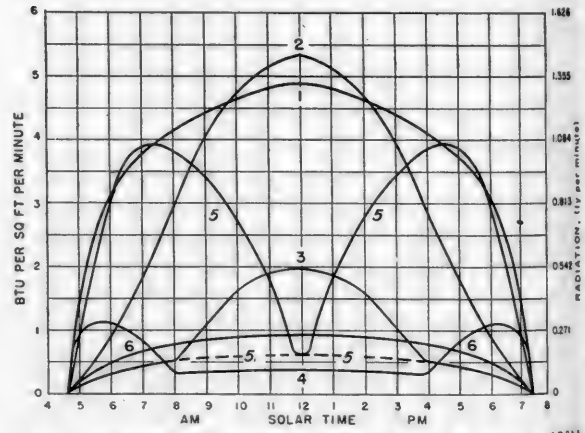


Fig. 10. Insolation on cloudless days, June 21, for latitude 40°N.

diffuse component, for an increase in atmospheric contamination increases the indirect energy. At Mount Evans and Pike's Peak, Colorado, the diffuse radiation on cloudless days at noon might not exceed 4% of the total, whereas in cities where soft coal is burned in quantity without benefit of smoke-eliminating devices, the diffuse component might comprise 40% of the total, or even more in extreme cases.

As a basis for making the calculations, we first obtained the mean of normal incidence energy received at various

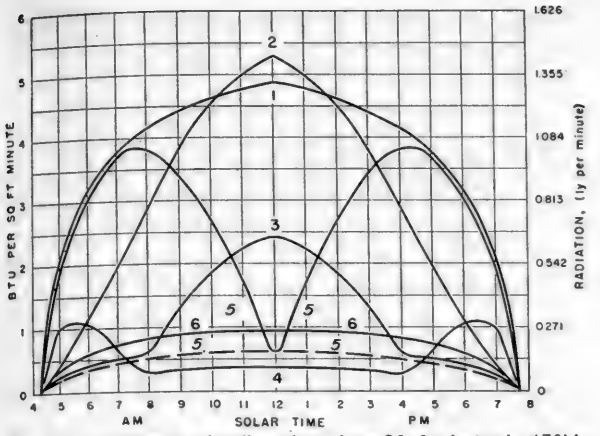


Fig. 11. Insolation on cloudless days, June 21, for latitude 45°N.

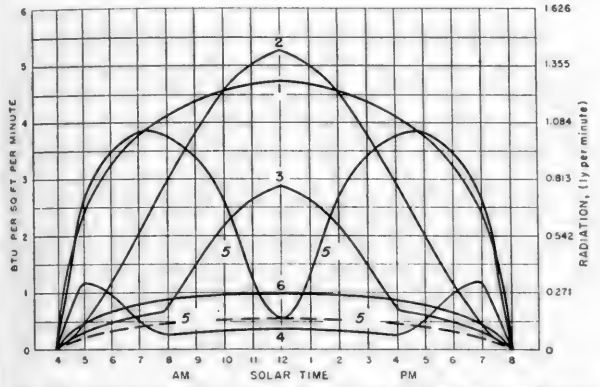


Fig. 12. Insolation on cloudless days, June 21, for latitude 50°N.

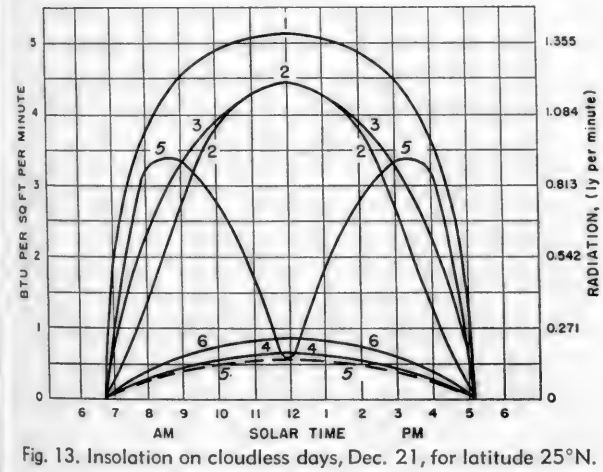


Fig. 13. Insolation on cloudless days, Dec. 21, for latitude 25°N.

stations throughout the United States and through use of simple trigonometrical formulas we computed the amount to be expected on various surfaces facing the cardinal points. Values of total solar and sky energy received on a horizontal surface at a large number of stations were plotted against latitude; and the amounts to be expected at the latitudes listed were obtained through simple interpolation. Description of instrumental equipment, sources of error, and other pertinent data are included in the article published in the January, 1950, issue of Heating and Ventilating. The earlier article also has a table which

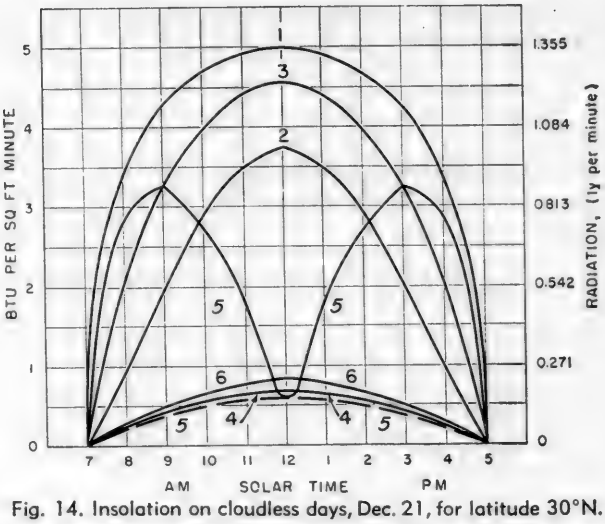


Fig. 14. Insolation on cloudless days, Dec. 21, for latitude 30°N.

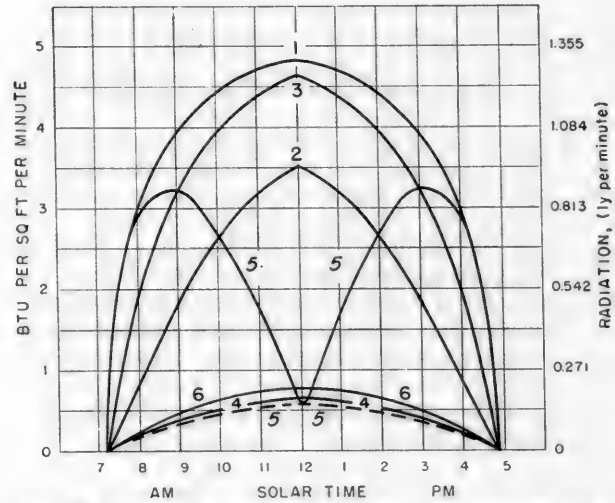


Fig. 15. Insolation on cloudless days, Dec. 21, for latitude 35°N.

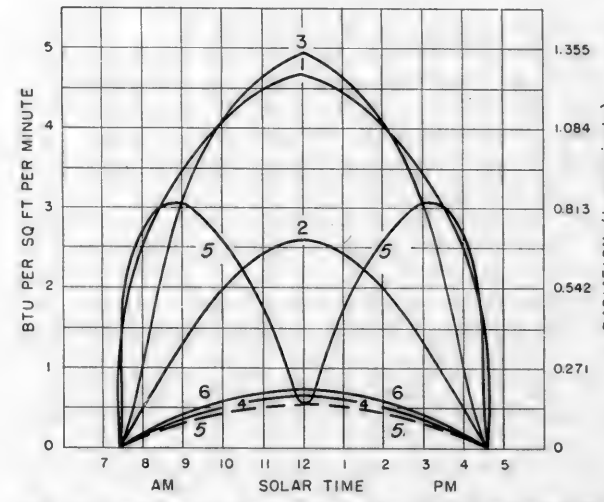


Fig. 16. Insolation on cloudless days, Dec. 21, for latitude 40°N.

gives representative values of insolation on cloudless days at Blue Hill Observatory, Milton, Mass.

In the illustrations, the numbers on the curves refer

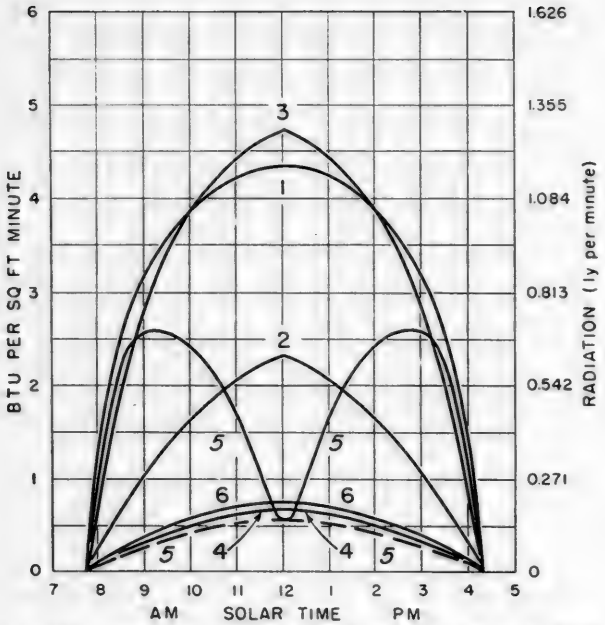


Fig. 17. Insolation on cloudless days, Dec. 21, for latitude 45°N.

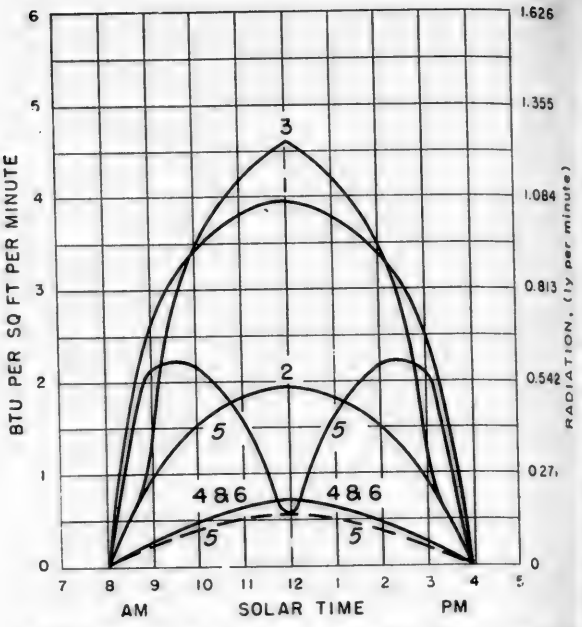


Fig. 18. Insolation on cloudless days, Dec. 21, for latitude 50°N.

to the surface on which energy is received as follows:

(1) Normal incidence.
(2) Horizontal surface.
(3) Vertical surface facing South.
(4) Vertical surface facing North.
(5) Vertical surface facing east during the morning and west during the afternoon, and also as a dashed line for vertical surface facing west during the morning and east during the afternoon. Obviously east is always higher in the morning hours and lower during the afternoon hours. The reverse is true of a vertical surface facing west. In other words, dashed lines are for the periods when the sun does not shine on the respective east and west vertical surfaces.
(6) Diffuse on horizontal surface.

Safeguards Against High CO in Traffic Tunnel

Constant measurement of the percentage of carbon monoxide gas in the Squirrel Hill Tunnel, part of the Penn-Lincoln Parkway, is performed by four carbon monoxide recorder instruments developed by Mine Safety Appliances Company, Pittsburgh. If the concentration reaches 2.5 parts in 10,000 parts of air, audible and visible signals are automatically actuated at the ventilation control panel, from which the operator controls the four giant fans housed in each of the two ventilation buildings at the portals of the 4,225 foot long twin-lane tunnels.

Two analyzers are located in each portal building. Air samples are drawn from points near the exit ends and from the main exhaust air ducts for each tunnel. All four analyzers are electrically connected to separate recording potentiometers mounted on the master control panel in the west portal building.

Each analyzer operates continuously on sample air drawn by means of a vacuum pump. The air passes through charcoal scrubbers which remove gasoline and petroleum vapors. It is dehumidified in automatically-regenerated drying units. The dry sample, free of any contamination other than carbon monoxide which may be present, is then introduced into a chamber containing a catalyst which causes carbon monoxide to be turned into carbon dioxide. During this chemical reaction, the heat liberated is accurately measured by a sensitive thermopile. The voltage developed is proportional to the percentage of carbon monoxide present in the air sample. No other common gases or vapors normally expected in the tunnel air can affect operation of the instruments.

Two exhaust and two fresh air supply fans are located in each ventilation building. They are powered by motors ranging in size up to 250 hp. The largest fan can move 285,000 cfm of air. To conserve power of fan motors, and to facilitate directional control of drafts in case of a fire in the tunnel, the ventilating system is manually controlled.

A chamber six feet high above the false ceiling of each tunnel is used as an air duct for ventilating air, which is circulated through a large number of openings located in the tunnel ceilings the entire length of the tunnel. The chamber is divided at the center of the tunnel by a transverse airtight bulkhead. From the entry of each tunnel inward to its center, these ceiling openings are used to exhaust air. Fans suck out fume-laden air and discharge it from an opening in the roof of the tunnel portal building.

Surface and Water Temperatures for Radiant Heating Systems

L. J. LaTART*, N. W. SMITH*, D. L. MILLS**

A common problem of the designer of a radiant heating system is the determination of the pipe or tube size and spacing in the panels and the mean water temperature required in the cells to produce the required panel output under design load.

SELECTION of heating units for conventional hot water heating systems using radiators, convectors, or baseboard units, is relatively simple, once the heat loss of the room has been determined and the mean water temperature for the system fixed. Standard ratings at various mean water temperatures are published by manufacturers of these units in different sizes. This information is very helpful to the designer of conventional hot water systems. He simply selects the proper size unit from a catalog depending on the calculated heat load and the available space in a room. One can readily understand the problems of the designer if it were necessary to design each heating unit separately, but as conventional heating units are standardized, their selection is ordinarily a simple matter.

The heating panels for a radiant panel system on the other hand can be considered as custom built or tailored for each room. This tailoring is necessary because the maximum heat output of a panel is dependent on its area, location, surface temperature, and the thermal characteristics of each enclosure. The designer of a radiant heating system has two important factors to consider. One involves the rate of heat emission required to produce comfort conditions in the occupied space, and the other the means of transferring the heat from the source to the surface of the panel. It will be seen that the former relates to heat transfer *from* the panel surface, and the latter relates to heat transfer *within* the panel itself.

Panel area is an important factor since panel heating systems utilize large areas at low rates of heat emission as compared to conventional systems where small heat sources with high rates of heat output are used. Under exceptional circumstances even where the entire floor or ceiling area is used for the heating panels at maximum recommended panel surface temperature, the heat output will not be sufficient to offset the heat loss of the room. In such cases conventional heating units requiring little surface area, compared to that required by radiant heating panels, could often be installed in a room to meet the heating requirements satisfactorily.

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**Member of ASHVE, TAC on Panel Heating.

The location of the heating panel in the room is important since it governs the rate of heat emission from the panel by convection. The radiation coefficient from a heating panel is practically constant regardless of the location of the surface but the convection coefficient changes significantly with the position of the surface.

Panel surface temperature under design load must be considered from the standpoint of comfort to room occupants and characteristics of the embedding material. Floor panels are generally designed to operate at a maximum surface temperature of 85F. since above this temperature the floor becomes uncomfortable. Ceiling panel systems may be operated at higher surface temperatures than floor panels, but the maximum panel surface temperature for comfort conditions is dependent on the ceiling height. Ceiling panels operating at 120F. would be uncomfortable to room occupants when the ceiling height is less than 8′ 6″.

The characteristics of the embedding material limit the mean water temperature in the coils. If the water temperature is too high cracks and discoloration on the panel surface may develop.

Thermal characteristics of an enclosure directly affect the heat output from a panel. At a fixed panel surface temperature and location, an increase in the temperature difference between the panel surface and the room surface, will increase the output of the panel. Any panel will have a greater heat output in an uninsulated room than in a similar insulated room of equal size, because the temperature difference between the panel surface and the room surface under design load would be greater.

The conductance (c_p) within the panel itself is affected by the thermal characteristics of the embedding material and the spacing of the pipe or tube in the heating coils. Any panel of given construction will have only one conductance value which is not affected by conditions exterior to the panel. The energy transfer within any panel from the heat source to the surface of the panel is by conduction only. The total energy transfer per square foot of panel surface area is the product of the conductance and the temperature differential between the heating medium and the panel surface.

Pipe or tube size in the heating coils affects chiefly the hydraulics of the heating system and is relatively

unimportant from the standpoint of heat transfer. Pipe or tube spacing in the coils in a panel; on the other hand, has a significant effect on the conductance within the panel as shown in Table 1.

The foregoing may give the impression that the determination of panel requirements for radiant heating systems is difficult. The following procedure, on the other hand, shows how simply this can be done by use of the two equations given.

Procedure

(1) Determine heat loss of room in Btu per hour by any accepted method without including any loss through the area occupied by the heated panel.

(2) Determine the panel rating in Btu per (hour) (sq ft of panel area) by dividing the total heat loss in Btu per hour by the assumed panel area, which may be all, or a percentage (90%, 80%, etc.) of the available ceiling or floor area.

(3) Determine the maximum panel surface temperature (t_p) under design load by use of the following equation:

$$t_p = \frac{Q_p}{C_s} + 68$$

Where t_p = maximum temperature of panel surface, F

Q_p = panel rating or output in Btu per (hr) (sq ft of panel area)

C_s = conductance of panel surface (combined radiation and convection film coefficient) in Btu per (hr) (sq ft) (F)

C_s = 1.4 for gypsum plaster ceiling panels; 2.1 for concrete floor panels. The constant 68 applies to residential buildings, offices, and the like.

Maximum temperatures of panel surface should not exceed the following:

Plaster ceiling panels —	7.5 ft ceilings	100 F
	8 ft ceilings	110 F
	8.5 ft and above	120 F
Floor panels		85 F

(4) Determine the mean water temperature (t_w) required in the heating coils under design load by use of the following equation:

$$t_w = \frac{Q_p}{C_p} + t_p$$

Where t_w = mean temperature of water in heating coils. t_w should not exceed 150 F for plaster panels and 120 F for floor panels

C_p = conductance within the panel in Btu per (hr) (sq ft of panel area) (F difference between average temperature of water in coils and average temperature of panel surface)

TABLE 1.—VALUES FOR C_p

Tube Size, Inches	Gypsum Plaster Panels* Tube Spacing (c-c), Inches			Concrete Panels** Tube Spacing (c-c), Inches	
	4	6	9	9	12
⅜	2.32	1.50	1.07	1.34	0.96
½				1.39	0.98
¾				1.44	1.00

*Where the coils are located above but in good contact with expanded metal lath and where insulation above the panel will produce negligible reverse heat loss.
**Where the depth of bury of the coils does not exceed 3 inches.

Example

(1) Determine heat loss of room
Assume a room 10 by 12 by 8 ft having a heat loss of 4,000 Btu per hr in which a ceiling panel will be installed.

(2) Determine the panel rating
Assume a panel area occupying 80% of the ceiling area.

Area of ceiling = 10 x 12 = 120 sq ft
Area of heated panel = 120 x .80 = 96 sq ft

$$\text{Panel rating} = \frac{4000}{96} = 41.6 \text{ Btu (per hr) (sq ft)}$$

(3) Determine the maximum panel surface temperature (t_p)

$$t_p = \frac{Q_p}{C_s} + 68$$

$$t_p = \frac{41.6}{1.4} + 68$$

$$t_p = 29.7 + 68$$

$$t_p = 97.7 \text{ F}$$

(4) Determine the mean water temperature (t_w) required in the heating coils under design load. Assume ⅜-inch copper tube spaced 6 inches on centers for the coils.

$$t_w = \frac{Q_p}{C_p} + t_p$$

$$t_w = \frac{41.6}{1.5} + 97.7$$

$$t_w = 27.7 + 97.7$$

$$t_w = 125.4 \text{ F}$$

$$t_w = \frac{Q_p}{C_p} + \frac{Q_p}{C_s} + 68$$

$$= Q_p \left(\frac{1}{C_p} + \frac{1}{C_s} \right) + 68$$

⅜-inch tube in gypsum plaster on 9-inch centers

$$t_w = Q_p \left(\frac{1}{1.07} + \frac{1}{1.4} \right) + 68$$

$$t_w = 1.65\ Q_p + 68$$

The foregoing example illustrates how the method can be used to determine the mean water temperature necessary to satisfy the heating requirements of a single room. A designer being faced with this problem in several rooms, has at his disposal, three ways of "tailoring" the panels. Namely:

(1) By varying the mean water temperature.
(2) By varying the tube spacing.
(3) By varying the panel area.

The first method would permit full coverage of the available area with panels, since a reduction of the water temperature in each case, without changing the tube spacing, would limit the panel outputs in the rooms to their respective requirements. The control equipment necessary for such a system, however, if applied to each individual room, would be prohibitive in cost and therefore inadvisable.

Varying the tube spacing at a fixed mean water temperature would also permit the use of the entire ceiling or floor area as the heated panel. This method would simplify the control of such a system since only one water temperature would be supplied to all coils. However, it might require individual tube spacings for each room which would necessitate bending equipment of many sizes. If a number of tube spacings are required the time of installation will be materially increased.

Varying the panel area in individual rooms permits the designer to use a single tube spacing at a fixed mean water temperature to the coils throughout. After the panel ratings for all rooms have been determined, the highest panel rating is chosen as a standard design output. The necessary panel area for any room is then determined by dividing the total heat loss of the room by this design output. Thus it will be seen that the total heat emission of the panel is adjusted to satisfy the heat requirements of the room by varying the panel area. The panel ratings of bathrooms, entries, etc. should not be used as standard design output. The heat requirements for these rooms can be met by closer tube spacing than in other rooms. This will increase the rate of heat emission at any given water temperature.

This method is by far the best of the three suggested. Its simplicity should appeal alike to the designer and the contractor.

This discussion can best be illustrated by the following example. Table 2 refers to a typical six-room house which is to be heated by ceiling panels. The panel ratings of the rooms have been determined by dividing the total heat loss of each room by the available area referred to under Step 2 of the procedure given. Application of Equations (1) and (2) gives the values of panel surface temperature (t_p) and mean water temperature (t_w), based on an assumed tube spacing of 6 inches on centers.

TABLE 2.—PRELIMINARY ESTIMATE FOR SIX-ROOM HOUSE

Room	Panel Rating Q_p, Btu/(hr) (sq ft)	Panel Surface Temp., t_p, F	Mean Water Temp., t_w, F
Living Room	42	98	128
Dining Room	46	101	132
Kitchen	52	105	140
Bath	60	111	151
Bedroom 1	48	102	134
Bedroom 2	48	102	134

Since the bathroom is not a typical room either as to size or heating requirements, the kitchen, having the next highest panel rating would be selected as the room wherein greatest utilization of available panel area should occur. Therefore, a mean water temperature of 140 F should be used as a design value in this system having 6 inches on centers tube spacing.

In line with previous discussion, the tube spacing in the bathroom would be reduced to 4 inches on centers giving, by the use of equation (1), a value for t_w of 137 F, instead of 151 F shown in the Table above. The small temperature difference between the water required for the bathroom panel and other panels in the same structure can be overcome by means of a balancing cock.

It will be seen from this illustration that the varying heating requirements of the different rooms are met primarily through variations in the panel area, and secondarily, by varying the tube spacing. In both cases water at the same temperature would be supplied to all coils.

Should it be desired to operate certain rooms at a lower temperature than others, such as the two bedrooms, they could be operated on a separate zone with a different water temperature regulated by another set of controls. Panel areas could be determined within the new zone in exactly the same manner as previously described.

Quick Method For Flue Gas Analysis

A greatly improved method of analyzing flue gases in operating boilers over a wide range of temperatures, was revealed at the semi-annual meeting of the American Chemical Society in Chicago. The new method was described in a paper co-authored by E. K. Diehl, associate fuel technologist, and R. E. Matty, senior chemist, at the Research Center of the Babcock & Wilcox Company.

The paper described an improved method and apparatus for the determination of SO_2 and SO_3 in boiler flue gas at operating temperatures and brought out the fact that because there is an increasing amount of sulfur in the fuels being used today its presence can have a serious corrosive effect on certain portions of a steam generating boiler.

Employing one standard solution of sulfuric acid which can be kept indefinitely without appreciable change in strength, the new method eliminates unstable standard solutions, which had been used previously. With the relatively simple equipment, the method requires only a small table, standard laboratory glassware, and a source of distilled water. This is ideal for a field testing program, since laboratory facilities are not needed. The time required for completion of analyses has been reduced from one day to one hour, making it possible to collect samples during one test and obtain the results before a subsequent test on the same day.

Theory and Application of Thermocouples

E. A. MURPHY

Minneapolis-Honeywell Regulator Co., Philadelphia, Pa.

Flexible, reliable, inexpensive, and easily installed—thermocouples can measure temperatures ranging from around —300 F to upwards of 3000 F.

A couple of lengths of wire twisted together and welded at one end. That's all you see when you look at a thermocouple, but don't discount the tremendous value of this mighty midget just because of its unprepossessing appearance. Its very simplicity is one of the reasons why the thermocouple is more widely used for temperature measurement throughout industry than either the resistance thermometer bulb or the familiar bulb of the pressure type thermometer. Other reasons for its popularity are: (1) it has very little mass—it can be made small enough to fit into places where there would not be room for other types of temperature sensing elements; (2) it is easily replaceable—since it is connected electrically to the measuring instrument, replacement can be made quickly and easily; (3) with the exception of the precious metal thermocouples required for temperatures above 2000 F, thermocouples are the least expensive of the temperature sensing elements; (4) repairs and replacements can be made on the spot—there is no need to touch the measuring instrument; (5) special types of thermocouples can be designed for specific applications; and (6) there is practically no limitation on the distance between the thermocouple and the measuring instrument.

Having given a few reasons why the thermocouple is well worth knowing about, let's find out a little bit about what it is and how it works. In 1821 a man named T. J. Seebeck was experimenting on the difference of potential that was thought to exist when two metals were brought into contact. When he joined together the ends of two pieces of wire of dissimilar materials—say one of copper, the other of iron—as shown in Fig. 1, and heated one of the junctions (measuring junction T_1 in Fig. 1), he noted that an electric current flowed through the wires. Moreover, he noted that this current flowed *from the copper* to the iron wire at the measuring or hot junction, but *from the iron* to the copper at the reference or unheated junction. Here, then, was the first thermocouple.

This generation of d-c voltage by a thermocouple as explained by Seebeck is attributable to two effects. The first of these, the Peltier effect, which is directly responsible for the emf transmitted to the measuring instrument, stems from the facts that two dissimilar wires are welded together at one end, and that there exists a *temperature difference between the free and the welded ends.*

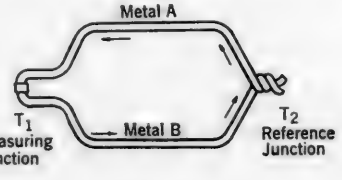


Fig. 1. Simple thermocouple circuit

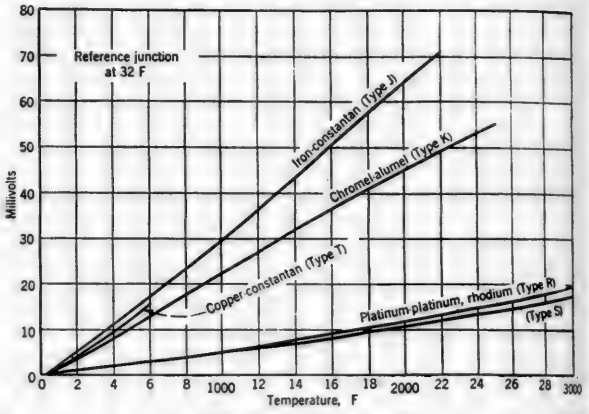


Fig. 2. Emf versus temperature for five thermocouples used in industry.

However, it is the Thompson effect which makes a thermocouple practical for industrial use. This effect states that the emf generated by a thermocouple depends upon the existence of a temperature gradient along each of the two wires. It is because of this effect that it is possible for a thermocouple to measure the true temperature existing at its measuring or hot junction, even though the temperature at some point between the measuring and reference junctions may be above the measured temperature.

Small Voltages Involved

The magnitude of the emf developed by a thermocouple is in the order of from 3 to 17 millivolts at 600 F depending upon the composition of the two metal wires used as shown in Fig. 2. It can be seen that the emf increases fairly linearly with temperature and that different combinations of metals give different curves. Although this graph shows only the emf's generated between 0 and 3000 F, Copper-Constantan thermocouples can be used satisfactorily in the lower ranges. In fact, they are particularly well suited for measuring temperatures from —300 to +600 F.

E. A. Murphy graduated from Georgia Tech in 1932 with a B.S. in Mechanical Engineering. After serving nine years as a buyer of hardware and power tools for Sears, Roebuck in Atlanta, he was inducted into the Army and served with an anti-aircraft unit in the Southwest Pacific. He was discharged from the Army in 1946 and became a technical writer for the Industrial Division of Minneapolis-Honeywell Regulator Company in Philadelphia. In 1952 he moved into his present position as managing editor of the division's quarterly publication, Instrumentation.

Since the emf developed by any thermocouple is a function of the temperature difference between the measuring (welded) junction and the reference (unwelded) junction, the curves in Fig. 2 (and most instrument manufacturers' tables) are based upon a standard reference junction temperature of 32 F.

However, in practice it is not necessary to maintain this reference junction at 32 F, although occasionally, in research or laboratory work this is done by immersing the cold junction in an ice and water bath. The normal manner of incorporating a thermocouple into a thermoelectric pyrometer system is illustrated in Fig. 3.

As shown, the thermocouple is attached to a connection head which is connected electrically to an indicating or recording instrument. The conductors between the connection head and the instrument are known as extension-wires and may be either of the same metals that go to make up the thermocouple, or of other metals having the same thermoelectric properties. These extension wires actually extend the reference junction of the thermocouple (which would otherwise be at the connection head) to the instrument. Incorporated in the instrument are internal extension-wire, and an ambient temperature compensating device which compensates for minor variations in the reference junction temperature. The use of this latter device makes it unnecessary to maintain the reference junction at any fixed temperature.

Complete Temperature Measuring System

Since, in response to an increase of the temperature at its measuring junction (for all practical purposes, the reference junction n the instrument is considered to remain at one fixed temperature, thanks to the compensating device), a thermocouple generates a proportionately increased emf, it can be employed in conjunction with either a millivoltmeter type instrument or a null-balance type of electronic instrument.

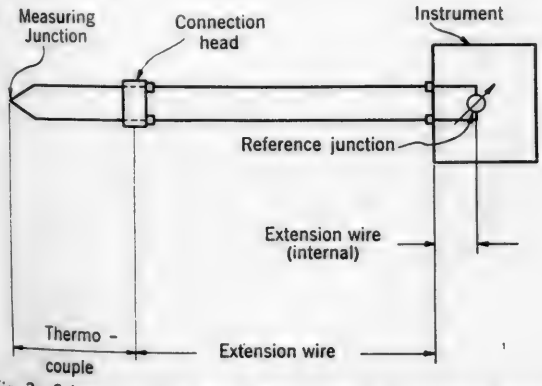


Fig. 3. Schematic diagram of thermoelectric pyrometer system.

The former is frequently used when an indication only is wanted, and no permanent temperature record is required. The millivoltmeter is the least expensive of the instrument family and can usually be supplied with a control unit so that it can energize compressor motors, signal lights, valves, or some other control accessory.

Where extreme accuracy is required, where a continuous chart record is wanted, and where the application calls for some of the more complex forms of automatic control such as proportional or proportional-plus-reset, the electronic null balance instrument is preferable.

This instrument draws no current from the measuring circuit when it is at its point of balance (i.e. when it is indicating or recording the true measured temperature) and for this reason the resistance in the measuring circuit has no effect on its operation. For this reason, also, it is well suited for applications where the point of measurement (the thermocouple) may be thousands of feet from the instrument. This is not true in the case of the millivoltmeter since the millivoltmeter must, by nature of its construction, draw current from the measuring circuit, and is therefore affected by the resistance of the extension-wire connecting it to the thermocouple. While its accuracy is not affected by long lengths of extension-wire, it loses some of its sensitivity, i.e. its ability to react to and indicate very small changes in the measured temperature.

Extension-wire, as previously mentioned, is used to connect the thermocouple to the measuring instrument. Each type of thermocouple (these types will be described later) has its own specific type of extension-wire.

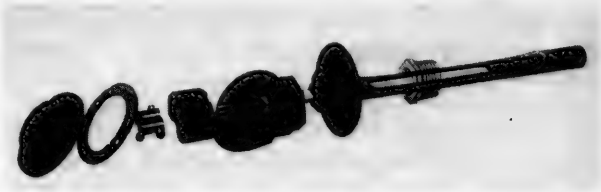


Fig. 4. Exploded view of typical industrial thermocouple assembly.

Shown in Fig. 4 is an exploded view of a typical industrial thermocouple assembly. Basic components are: (1) the thermocouple proper; and (2) the connection-head, which includes a ceramic terminal block to which the thermocouple wires and the extension-wires are connected, and a gasketed cover. These connection-heads are supplied in the general purpose type (illustrated) and in a screw cover type which is completely weatherproof and suitable for outdoor installations.

In addition to these basic components, industrial thermocouple assemblies usually include protecting tubes or wells. The tubes are attached to the connection-head as shown in Fig. 4 and protect the thermocouple from harmful gases or liquids, as well as from mechanical damage. Protecting wells are pressure-tight vessels with external threads that permit the well to be screwed into a pressure vessel or a pipeline. Through the use of these

wells it is possible to replace thermocouples when the vessel or pipeline is under pressure.

What Kind of Thermocouples Are There?

There are five types of thermocouples in common use throughout industry. These are:

Copper-Constantan (Type T)
Iron-Constantan (Type J)
Chromel-Alumel (Type K, Hoskins Corp.)
Platinum, Platinum-Rhodium (Type R and Type S)

The first three are known as base metal thermocouples, while the R and S types are called noble metal thermocouples. Because of their cost, and the low emf produced by them in the lower temperature regions (see Fig. 2), the use of noble metal thermocouples in industry is usually limited to those temperatures above the range of the chromel-alumel couple. For this reason, we will not go into any further details about them.

Copper-Constantan (Type T): These couples consist of a pure copper wire (positive conductor), and a copper-nickel (constantan) wire (negative conductor). They are low in cost and are well adapted to refrigeration and cold storage work because of their useful range of —300 to +600F. They have a high resistance to corrosion caused by moisture condensation or atmospheric moisture, another point in their favor for the measurement of sub-zero temperatures.

Originally used on laboratory and pilot plant applications, they are now widely used industrially and since they can be furnished with a higher degree of accuracy in the —300 to +300F range than any other commercially available couple, they are used extensively for low temperature measurement. They can be used in either exodizing or reducing atmospheres.

Iron-Constantan (Type J): With one iron wire (positive conductor) and one constantan wire (negative conductor) these couples are normally used to measure temperatures from about 0 to 1400F, and will perform satisfactorily in either oxidizing or reducing atmospheres. Also relatively low in cost, they too, are widely used.

Chromel-Alumel (Type K): Having one nickel-chrome alloy wire (positive conductor), and one nickel-aluminum alloy wire (negative conductor), these couples are recommended for temperatures from 1000 to 2000F. Somewhat higher in cost than Iron-Constantan couples, these couples give best service in oxidizing atmospheres, but if supplied with suitably ventilated protecting tubes, can be used in atmospheres, that are reducing or oxidizing.

Thermocouple Wire and Extension Wire

In general, smaller wire sizes give greater speed of response because of the resulting smaller mass of the bare thermocouple or the smaller diameter protecting tube that can be used. On the other hand, the use of heavier gage wire results in increased thermocouple life. This factor is important only when the couple will be exposed to corrosive gases or liquids and elevated temperatures or is subjected to considerable vibration. The following are some recommended wire sizes:

Iron-Constantan and Chromel-Alumel....	8, 14, 20, 24, 28 B&S Gage
Copper-Constantan....	14, 20, 24, 28 B&S Gage

Insulated Thermocouple Wire: Lengths of matched pairs of insulated thermocouple wire can be obtained in limited wire sizes where the user makes his own thermocouples, such as for peening on the surface of piping and where no protecting tube is required.

When this type of wire is used, it is usually run from the thermocouple directly to the indicating or recording instrument in place of extension-wire. The insulation employed is similar to that used on extension-wire.

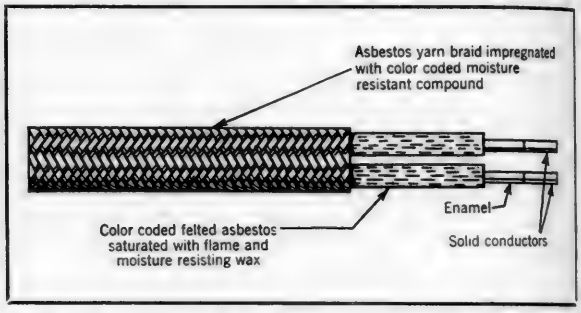

Asbestos yarn braid impregnated with color coded moisture resistant compound
Enamel
Color coded felted asbestos saturated with flame and moisture resisting wax
Solid conductors

Fig. 6. Enamel and felted asbestos insulated extension-wire with over-all asbestos yarn braid.

Extension Wires: There is a specific type of extension-wire supplied for service with each type of thermocouple. While it would, of course, be perfectly permissible to use for extension-wire, the same types of wire of which the thermocouple is made, this practice would become rather expensive on applications where Chromel-Alumel couples were employed or several hundred feet of wire or a large number of thermocouples were involved. For this reason, extension-wire, which is lower in cost than thermocouple wire, is used.

Insulating Materials

Various types of insulting material can be supplied. For example:

Polyvinyl Plastic-Weatherproof has a high resistance to alcohol, gasoline, grease, oil, and most acids and alkalies. The individual plastic-coated wires are covered with an over-all cotton braid saturated with a weather-proofing compound, and finished with a color-lacquer or paint. A section of this wire is shown in Fig. 5.

Asbestos-Covered wire, illustrated in Fig. 6, is recommended for use where the extension-wire will be exposed to temperatures from 140 to 400F. The individual wires are first coated with enamel and then covered with color-coded felted asbestos which is impregnated with a flame and moisture resistant wax. The two wires are covered over-all with color-coded asbestos braid.

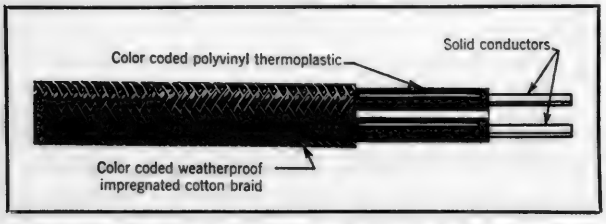


Fig. 5. Polyvinyl plastic insulated extension-wire with over-all weatherproof braid.

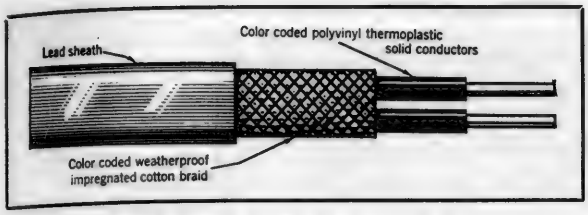

Lead sheath
Color coded polyvinyl thermoplastic solid conductors
Color coded weatherproof impregnated cotton braid

Fig. 7. Lead sheathed extension-wire.

Lead-Sheathed wire, as shown in Fig. 7, has a protective lead sheath over polyvinyl coated extension-wires. This combination, shown in Fig. 7, provides protection for the wires when they are not run in a conduit, and affords high resistance to moisture and many corrosive atmospheres.

Rubber-Jacketed Stranded wire provides great flexibility and is primarily employed for portable use. Having rubber-covered individual stranded conductors, this wire is moisture resistant but is not recommended for applications where it will be exposed to temperatures in excess of 125F.

Note that all extension-wire is color-coded to permit ready identification of the positive and negative conductor. This is important since the emf produced by a thermocouple is d. c. and failure to connect the extension-wire correctly to the thermocouple or instrument, i.e. getting the polarity reversed, will, of course, cause serious errors in the indicated or recorded temperature values. Also, the outside or over-all cover is color coded, since the use, with an iron-constantan couple, wire intended for use with a copper-constantan couple will likewise cause errors.

Typical Thermocouple Applications

There are many examples of the use of thermocouples on heating, and refrigerating applications. Outstanding in this respect is the huge Climatic Hangar erected by the United States Air Force in 1946 at Eglin Air Force Base, Florida. This gigantic structure is 250 feet by 200 feet by 70 feet, and capable of handling a B-36 bomber. It is used for functional testing of aircraft and other equipment at temperatures over a range from —65 to +160F. In order to run the low temperature tests over periods of time ranging up to three months, 100,000 pounds of refrigerant are used to give 1,200 tons of refrigeration at —65F. As shown in Fig. 8, thermocouples, mounted at various locations within one of the planes being tested, transmit their millivoltage through cables to recording instruments mounted in heated, insulated portable booths such as shown in Fig. 9.

Fig. 8. B-29 undergoing heater test at —65 F. Thermocouples in plane sense temperatures, transmit readings to recording instruments in heated, insulated portable van (left).

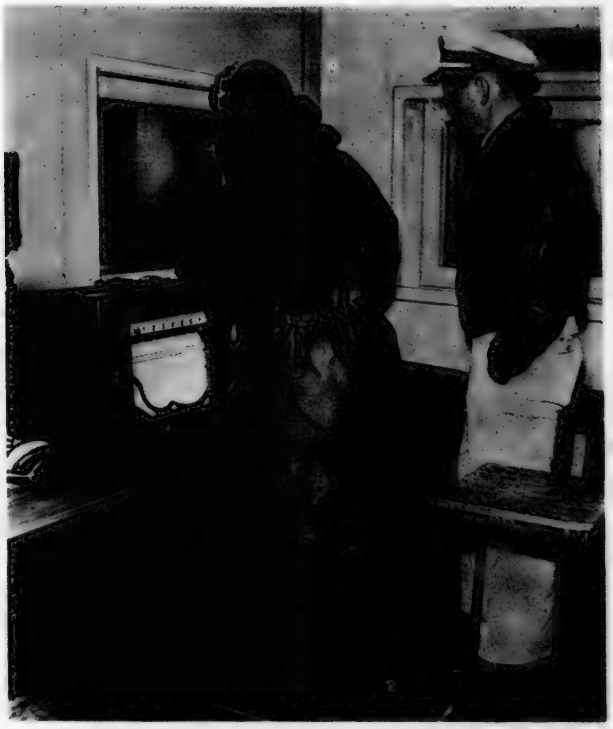


Fig. 9. Instrument in portable insulated, heated van records temperatures sensed by thermocouples in test plane being subjected to —65F temperature in Climatic Hangar.

In an installation of this size, with a number of jet and propeller driven planes in operation, fire is an ever-present hazard. To guard against this hazard, a number of thermocouples are spaced along the entire ceiling and wired in parallel. They are attached to the instrument shown at the top of Fig. 10. This instrument is equipped with a cam, a follower, and a micro-switch, and sounds an alarm if the temperature at any point along the ceiling reaches a level of 20F above the temperature at which the hangar is being operated.

Other instruments on this panel are two electronic stop chart recorders and an electronic precision indicator. All are connected to thermocouples some distance away in the test area.

Permanent Installation

The structural and insulating problems stemming from the operation of a structure enclosing around 2,900,000 cu ft and operated at such extremes of temperature are considerable, and many thermocouples are permanently installed throughout the building. Readings from these are transmitted via thousands of feet of extension-wire to centrally located instruments such as shown in Fig. 9 and 10. These thermocouples are sealed at various points

Fig. 10. Instrument at top receives signal from number of thermocouples mounted along hangar ceiling—sounds alarm if ceiling temperature raises above preset level. Other instruments indicate and record temperatures sensed by thermocouples in test area.

within the insulation, within the concrete floor slabs, and in the ground beneath the floor. At each of sixteen locations within the walls and ceilings, five couples are installed at varying depths in the insulation to provide data on temperature gradients.

In Office Buildings, Too:

Another application of thermocouples that is increasing in popularity, is the centralized indication or recording of a number of different temperatures in a large structure such as an office building. A nine floor and basement building in Omaha that houses the Mutual of Omaha and its companion companies is an excellent example. The building is air conditioned, being maintained at 76F throughout the year, with a relative humidity of 35% in the winter and 50% in the summer.

In the early stages of planning temperature control it was decided that it was essential to have a means of knowing, quickly and accurately, the temperature in any given part of the building so that, when necessary, adjustments could be made to the building thermostat settings. Temperature-setting knobs on all thermostats are kept locked so that settings can be changed only by members of the maintenance staff. Since it would take a man approximately five hours to take temperature readings throughout the building, some central means of accomplishing this was essential.

The problem was solved through the use of a number of wall-mounted thermocouples, located near the thermostats, and an electronic precision indicator mounted on

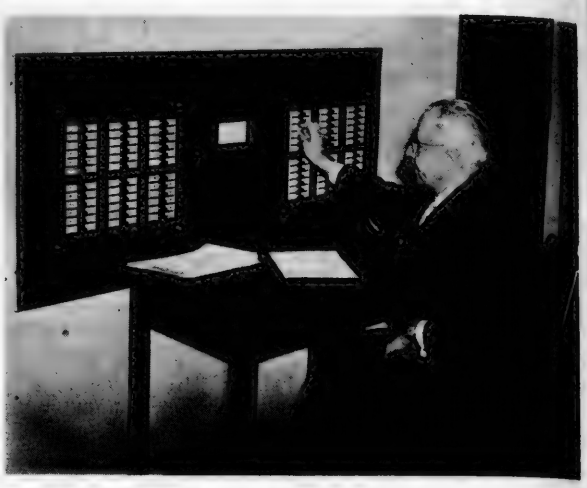


Fig. 11. Centrally located instrument can indicate temperatures measured at 144 locations throughout large office building.

the ground floor. This instrument, pictured in Fig. 11, is equipped with built-in push-buttons (one for each thermocouple location) and can handle up to 144 thermocouples. As each push-button is depressed, the instrument rapidly indicates the temperature measured by that particular thermocouple.

119 Temperatures

At present, the instrument at the Mutual of Omaha building is measuring 119 temperatures—in every private office; in every zone of each floor; outside air temperature; temperatures in the chilled water lines and forced air intake, and in numerous other places. The remaining switches will be used for the monitoring of other temperatures as the need arises.

To date, over 44,000 feet of extension-wire serves to connect the various thermocouples with the precision indicator. Although this is a lot of wire, its installation has already paid handsome dividends. For example, a complete temperature survey of the building can now be made in a matter of minutes.

Fuel Saved

To give another example, during a severe winter snowstorm, the dampers on the fresh air intake froze open.

Ordinarily, this condition might go undetected for several hours. During this entire period the building thermostats would attempt to maintain their set temperature, and a lot of expensive steam would be wasted.

However, the rapid, routine check made possible by the monitoring system, quickly uncovered this abnormal condition, and it was possible to take corrective action in time to prevent the unnecessary expenditure of a sizable amount of costly fuel.

In addition to the saving in steam costs there was also the important factor of preserving comfort conditions throughout the building, a matter of special significance since around 80% of the employees were women, who, as a rule, are said to be more temperature conscious than men.

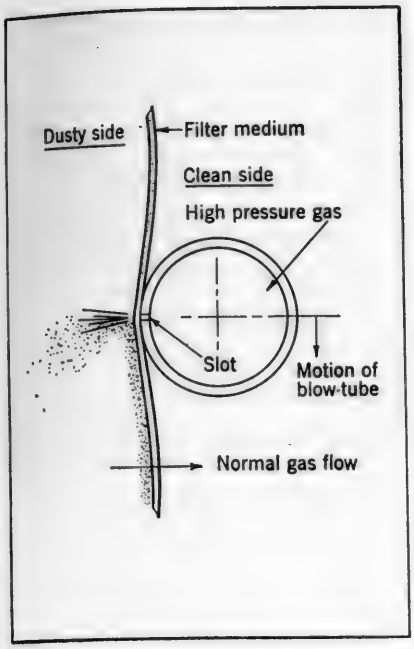


Fig. 1. Relation of blow-tube to filter medium.

New Developments in Reverse-Jet Filters

H. J. HERSEY, JR.

Extended industrial application of the reverse-jet filter has demonstrated both strengths and weaknesses, and has led to developments and inventions for making this relatively new type of filtering dust collector of greater usefulness and scope. This paper attempts to explain some of the less obvious problems, features, and possibilities of the reverse-jet filter.

THE reverse-jet method of filtering dust and some types of fume from air and other gases is not just another way of cleaning bags. It is distinguished by the use of a thick dense filter medium which increases the effectiveness of the filtration processes independent of the bridging of interstices such as exist in woven fabrics. Hence, it can filter at much higher velocity per unit area. Porosity of the filter and constancy of pressure drop are maintained by a slot-formed jet of high velocity air injected through the medium in reverse direction to the filtration flow. The jet moves progressively over the filter medium by means of a moving slotted tube which actually contacts, in fact indents, the filter medium (Fig. 1)—an essential consideration which distinguishes the method from ordinary, so-called blow-back filters which are incapable of producing similar results.

The basic method in its simplest form consists of one or more wool felt tubes which are surrounded by slotted rings moved up and down by chains or cables, and fed with air by a hose from a positive displacement blower, or a high pressure centrifugal fan. Fig. 2 illustrates an early form.

Control of the Jet Action

In an assembly of 12-foot-long tubes, only one half of one per cent of the filtering area is occluded at any time by the porosity maintaining action, and there is no need for temporary shutdown of a section being cleaned or the consequent loss of controlability of prevailing pressure. Hence a degree of automatic control is possible which has not before been attainable. This provides constant volume irrespective of variations in the amount or character of the dust.

Constant volume is essential to ideal operation of any dust collecting system but has not been obtainable where panel type filters were employed. Time-cycle operation does not accomplish the same result because the resistance of a filter is not a function of time, but of the amount and character of the dust, and of atmospheric conditions.

The value of control by the pressure drop is well demonstrated by an installation recently observed at a smelter crushing plant where the volume would vary between 20,000 and 26,000 cfm with three dusts of different physical properties varying in amounts according to the moisture content of the parent material. The pressure control

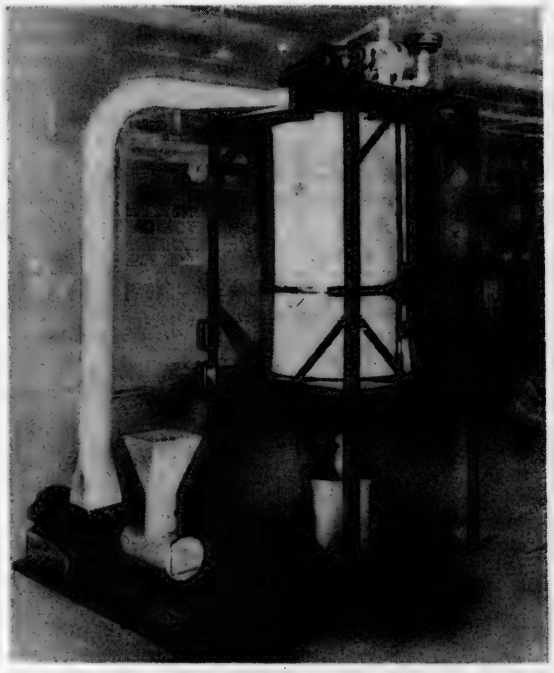


Fig. 2. An early model of the Hersey reverse-jet filter.

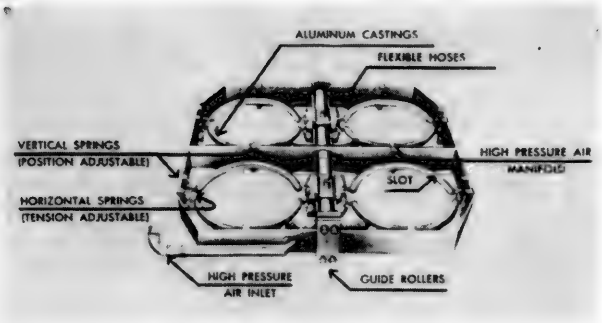


Fig. 3. Self-adjusting blow ring assembly.

switch is set for design volume with the maximum normal quantity of dust, although the dust load occasionally exceeds that for short periods. This setting is 21,000 cfm at 3.0 inches w.g. pressure drop with loading at 15 grains per cubic foot, under which conditions the jet operates all of the time. However, the dust load is usually below 15 grains. Between 10 and 1 grains, reverse-jet operation is only 30% to 12% of the time with the volume variation automatically held to ±3%.

A reverse-jet filter will almost always operate at a lower average pressure drop with the jet in continuous operation. (The only exception is when the dust is of such a character that time for agglomeration or flocculation aids the jet in removing it to such an extent that an occasional trip over the filter surface is more effective in terms of average pressure drop than continuous trips which keep it dispersed, and redepositing.) The lower pressure drop may, however, be expensive in terms of varying air volume, higher maintenance and lower dust retention efficiency. Table 1 shows the results of many hours of recordings of the cost, in terms of pressure drop, of several percentages of reverse-jet operating time under control by pressure drop, on several field application. In the lower ranges of reverse-jet operation percentages, there will usually be additional power cost to overcome resistance, but the saving on high pressure reverse-jet air offsets the cost of the higher pressure drop on the main fan. The saving in maintenance through control by pressure drop is obvious and, where applicable, is justified by that alone.

Dust retention efficiency is affected by the reverse-jet action. Disturbance of the dust deposit causes some particles to sift through even dense wool felt. Therefore, the less reverse-jet activity there is, the higher will be the average collection efficiency. Automatic control of the jet to the minimum required to maintain constant volume is certain to provide higher overall efficiency than constant reverse-jetting. Tests at the Harvard Air Cleaning Laboratory showed approximately four times the penetration of talc through the felt with 100% as compared to 45% jet operation; one and a half times as much vaporized silica penetrated the felt with 100% as compared to 10% jet operation time; and three and one half times as much precipitated fly ash penetrated with 100% operation as compared to 7%.

TABLE 1—REVERSE-JET OPERATION RECORD

Item	Grain	Flour	Chemicals			
			D	D	D	A
Average dust load, grains per cu ft	0.60	0.92	6.9	7.7	8.0	13.1
Filtering velocity, fpm	19.5	13.3	6.7	6.7	6.7	6.7
Average pressure drop, continuous operation, inches w.g.	4.33	1.3	5.0	5.0	5.0	4.6
Average pressure, controlled operation, inches w.g.	5.15	1.6	7.0	6.2	5.7	6.0
Increase in pressure drop, inches w.g.	0.82	0.3	2.0	1.2	0.7	1.4
Time of jet operation with control, %	6.5	14.5	29.0	33.0	64.0	24.0

Filter Medium Treatments

Occasionally a dust is encountered which does not form a sufficiently stable deposit even in dense wool felt, to stand any reverse-jet action at all without some leakage, which may be objectionable although not visible as airborne dust. It is not a matter of particle size, as some of these dusts are very coarse compared to some which are retained at extremely high efficiencies. It has been noted that those few dusts exhibiting this behavior are non-flocculating. Static electrical charges do not appear to have a bearing on seepage. For instance, a fine bronze powder carrying no measurable charge presents a seepage problem. Also, pigment grade TiO_2 on the order of one micron or less in particle size, and which has a tendency to flocculate, presents no seepage problem, but the same chemical in a technical grade, having 8- to 10-micron particles that do not readily flocculate, presents a serious seepage problem.

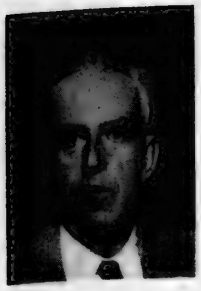
When the felt is given a special treatment, the tendency of dusts to seep through is practically eliminated. In the case of bronze powder, the treatment eliminated all visual evidence of seepage. The same was true with technical grade TiO_2, certain resins, cement dust, starches, etc.

The most complete and accurate investigation to date of the effectiveness of treated over plain felt was made by Knowlton J. Caplan and M. G. Mason in the test of a reverse-jet filter collecting a radioactive dust, most of which was less than one micron in particle size and exhibited excessive seepage through plain felt. Their tests showed that at the end of 110 days service a plain felt bag gave a collection efficiency of 99.25% whereas a treated bag at the end of 158 days service had a collection efficiency of 99.920%.

Self-Adjusting Blow Rings

As was pointed out in the first part of this paper, the contact with, and even indentation of, the filter medium is of primary importance. For optimum performance it is critical within narrow limits. An adjustment of only ⅛ inch, in terms of radius, made in the field recently, increased volume from 22,800 cfm to 26,300 cfm and reduced the filter resistance from 2.8 inches w.g. to 1.8 inches w.g. in a few minutes of operation.

Wool felt, and probably any other material with like filtering properties, is inherently dimensionally unstable, and in any case the need of perfect alignment of tubes is an undesirable requirement. Consequently, it has been deemed necessary to provide for this with means for automatic adjustment relative to the tube diameter and align-



H. J. Hersey, Jr., is a graduate of the Colorado School of Mines and began his professional life as a mining engineer. He originally became interested in dust collection problems through experience with silicosis and other dust problems in the mining and smelting field. His first experiments with the reverse-jet method were made in 1939, but before more than a few trial field installations could be made, the war with its needs for priorities interrupted development work. During the war he developed and manufactured, primarily for welding ventilation in shipholds, the flexible exhaust hose now known as Flexaust. Development work on the filter was resumed after the war, and the first commercial filters were put on the market by Hersey's licensees in 1947. Since then he has devoted his time and effort to further development of the reverse-jet principle as well as other possible methods representing fundamental advances in the art of dust and fume filtration. He is a member of American Industrial Hygiene Association, and this article is based on a presentation before the annual meeting of that group.

ment. As diameter cannot be changed except within the limits of the elasticity of the tube material without the formation of wrinkles with consequent wear, it is necessary to oval the tube cross-section by means of segments which are of somewhat greater radius than the tube itself.

A means of accomplishing this is shown in Fig. 3. Various needed design features were disclosed by this development, and other designs of self-adjusting rings will soon appear, but with the same objectives.

Wear of clean wool felt by smooth metal surfaces is negligible in the absence of chemical attack or other adverse conditions, as proven by tube life of over four years to date on some of the early installations. However, uniform conditions must prevail if such service is to be obtained. Self-adjusting rings offset such variables as tube stretch, uneven stitching, and occasional unexpectedly high pressures due to accident or maladjustment in the system or collector.

Redeposition

The capacity of reverse-jet filters is adversely affected by redeposition of part of the dust removed by the jet, especially when it consists of readily dispersed non-flocculating particles of relatively low apparent specific gravity. With tubes relatively long in relation to diameter, a window reveals that there is almost no settlement of fine dust into the hopper except as the reverse-jet approaches it on the down trip, indicating redeposition is taking place at all other times. The importance of this action is also indicated by plotting resistance in a single tube against the vertical position and direction of the jet, which shows it decreasing as the lower extremity of travel is approached. Still another proof is that experiments and observations show that most of the retained decrease in resistance occurs on the down travel—recent recorded tests on cement dust showing 80% on down trip. The up-trip lessens the rate of pressure rise by disturbance of the particles deposited within the medium, but it does not dispose of an appreciable amount of the surface deposit. This is readily explained by calling attention to the presence of the cleanest portion of the filtering area immediately below the jetted dust cloud when the rings are on the up-trip.

The ideal solution to this problem would seem to be isolation of the jetted dust, with conveyance directly to the hopper. Patent literature is full of ideas for vacuum cleaning of the filter surface which perhaps had this problem in mind—but overlooked the secondary separation required at the point of deposit, and of course lack of ability to retain the desired equilibrium deposit discussed earlier in this paper.

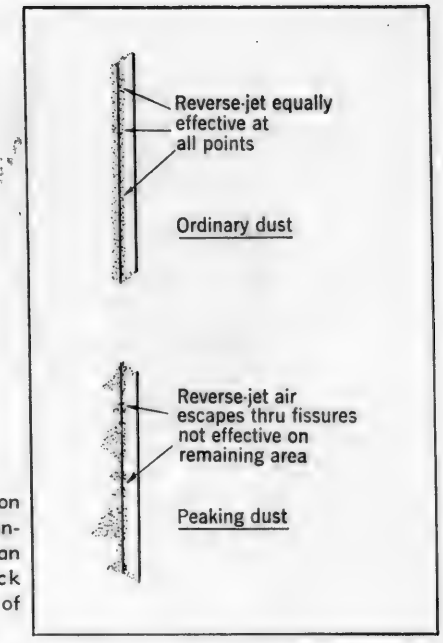

Reverse-jet equally effective at all points
Ordinary dust
Reverse-jet air escapes thru fissures not effective on remaining area
Peaking dust

Fig. 4. Illustration of fissures and pinholes formed by an excessively thick surface deposit of some dusts.

Thick Surface Deposit

Another cause of low capacity in some reverse-jet filter applications is the tendency of some dusts to flocculate or cling to the surface to such an extent that an excessively thick surface deposit is formed. The reverse-jet opens only pin holes or fissures in such deposits. In such a case, the jet acts only through these small openings, which is in effect the same as reducing the total of the active filtering surface to their total area. (Fig. 4) The ideal solution to this problem would be to pass a fine taut wire, or the like, so close to the filtering surface that a deposit of such thickness could not accumulate. As a practical dust collector design does not lend itself to the precision positioning such an ideal approach would require, a compromise has been made in the form of what might be called wipers, or sweepers. Their action is difficult to describe in that they do not brush or sweep off the thick deposit as implied—which action would of course shorten the life of the filter medium. Instead, they gently contact it just enough to disturb the cake that has been formed, and to interfere with further formation. They also tend to fill the fissures or pin holes, with resulting increase in their resistance, and better distribution of the effective pressure of the jet on its next passage over the filtering area.

New Forms of Reverse-Jet Filters

In an effort to overcome the limiting factors in performance previously discussed, a method of applying a reverse-jet in a way which would attack them in basic fashion was conceived. Dimensional instability of the filter medium was offset by mounting it on a screen support; redeposition attacked by providing a receiver to isolate most of the jetted dust from the cleaned surface; means for mounting a wiper to prevent excessive accumulation of deposit

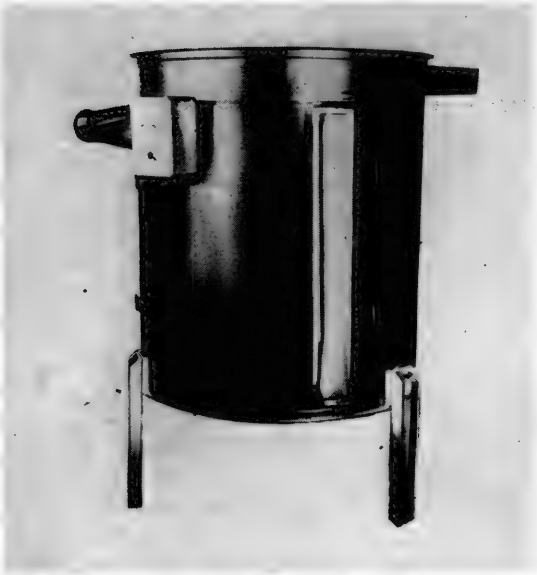


Fig. 5. External view of rotary-arm type filter. (Shown without hopper)

provided; and one directional motion to avoid reversal and the less effective up-trip arranged for by an assembly such as illustrated by Fig. 5 and 6, which is a test unit shown without the hopper.

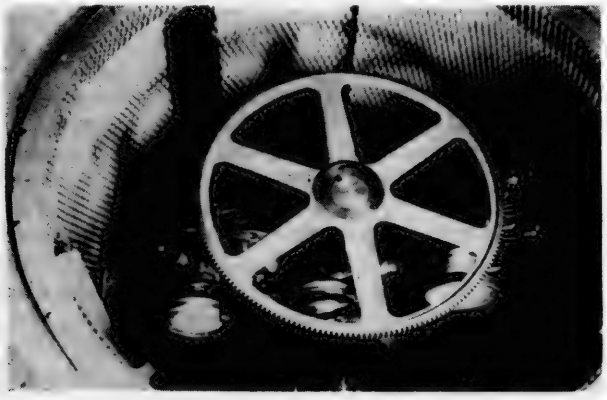
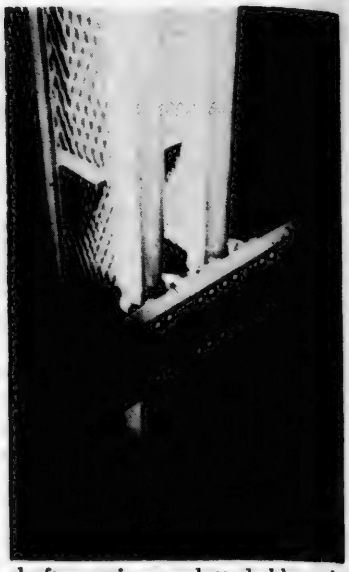


Fig. 6. (Above) Internal view of rotary-arm type, from above, showing blow-tube between screen support and filter, and drive mechanism for central shaft.

Fig. 7. (Left) V-panel style from front, or "dusty" side.

Fig. 8. V-panel style from clean side, showing blow-tubes and manifold. Drive mechanism not shown.



A central tubular shaft carries a slotted blow-tube around the cylindrical expanded metal screen supporting the filter medium. Opposite, on the dusty side, and supported from the same central shaft is the receiver, in or adjacent to which, is a wiper of any desired form. The essential in this, or like design, is the interpositioning of the blow tube between the filter medium and its support to provide the perfect contact and indentation of the filter medium referred to in the early part of this discussion as necessary for good results. In order to meet this requirement the blow tube has to be of very thin cross section, and both it and cylindrical screen support must be designed and assembled with sufficient precision to provide clearance, but a minimum of it, between them. Consequently this method of reverse-jet application is not easy to translate into large sizes.

Another application of the interpositioning of the blow tube between the filter medium and a support for it, is the V-panel form shown by Fig. 7 and 8 which illustrate only an experimental section of two V's or pleats. In commercial form there would be a multiplicity of these pleats. This form attacks only one of the limiting factors of the tubular form, which is dimensional instability of the filter medium. It is similar to the tubular type in all other respects, being actuated by the same type of reciprocating mechanism (not shown in the illustration). However it offers maximum filtering area in relation to space requirement, and in a rectilinear form for use on large volumes of air of relatively light dust content.

In conclusion, it might be said that the reverse-jet type of filter presents a filtering method which is capable of much higher filtration velocities at the same or higher efficiencies than previously experienced. Experimentation and analytical study of results obtained in several years of field application point the way to still further advances, some of which, discussed in this paper, are already accomplished fact, on an experimental and/or field application scale.

Unfortunately, at least for the experimenters, the reverse-jet principle adds several more interdependent variables to the already complex basic facts of filtration. Nevertheless, progress to date indicates even further improvement in the future in the prospects of a better tool for dust collection and air filtration.

What Would You Do?

Replies to engineering and operating problems of interest to the industrial plant engineer

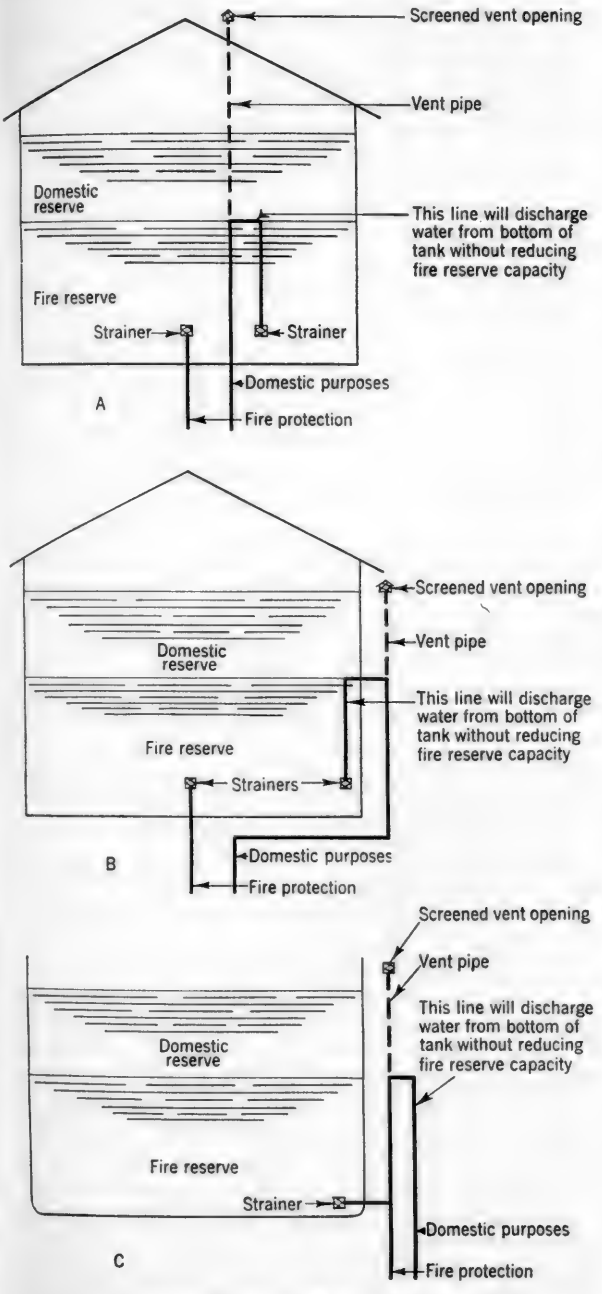
Conducted by
NATHAN N. WOLPERT
Associate Editor

This Month's Problem

We have a 7-story factory building and as part of the fire protection system we have a standpipe system that is supplied by a roof tank. Water for service needs is also drawn from this tank from a point above the fire line reserve. There have been complaints that the drinking water at times has an unpleasant taste. Is there some arrangement that we can use which will avoid such taste that comes, I believe, from poor flow?

HERE is a problem of interest to most industrial plant engineers. It concerns not only fire protection but also a taste-free domestic water supply.

Should you have a problem that you would like to see discussed in this department, or if you have some comments that you would like to add to the coming discussion, your letter to the Editor would be most appreciated.



Suggested Piping to Solve Problem.

This Month's Problem

The unpleasant taste of the drinking water could very easily be caused by the stagnant fire reserve water in the roof tank.

Roof tanks generally have a fire reserve and a domestic water reserve. The fire reserve is in the lower portion of the tank and the domestic water reserve in the upper portion of the tank. During normal use, the domestic water skims over the fire reserve to serve the needs of the building.

There are times, however, during the periods of peak use, or during tank filling operation, when the stagnant fire reserve water will be sufficiently agitated to mix with the domestic water. This mixing will impart the unpleasant taste to the drinking water.

There are several methods that may be employed to

Problem for the Coming Issue

We have a ventilation problem. Fumes given off from a tank during a hot dip cleaning operation are not properly handled by the hood which draws in the air at the rear of the tank along the long side. The tank is 7 ft long by 3 ft wide and we use an air velocity of approximately 2,000 fpm. What should be the slot width? If we increased the velocity to 2,500 fpm, then what should be the slot width?

improve the quality of the water in a combination tank of this type as follows:

(1) Cleaning—Periodic cleaning of the tank will help to keep the water clean and fresh. The disadvantage of this method is that cleaning is costly and requires a disruption of service.

(2) Chemical treatment—Adding approved chemicals to the water in the tank will cause foreign material in the tank to settle to the bottom to be removed later when the tank is cleaned. These chemicals also check the growth of algae and improve water quality. The disadvantage of this method is that chemical treatment must be periodic and it will still be necessary to clean the tank at regular intervals to prevent the sludge from piling up.

(3) Change of Piping Connections—This method requires the change in the domestic water connection to the tank and the change in piping permits the domestic water to be supplied from the bottom of the tank without lowering the fire reserve level. Thus all the water in the tank will be kept in motion, and therefore will have a fresh, clean taste. A system of this type will require slight maintenance and little, if any, cleaning.

In sketches *A*, *B* and *C* which show typical applications, only the domestic and fire line connections are shown. Not illustrated are the valves, equipment and other connections. Sketch *C* was shown in detail as part of HEATING AND VENTILATING'S Detail Sheet in the November, 1953 issue.

Louis Blendermann
Engineer

Glen Cove, N. Y.

For any standpipe system, supplied by gravity from a roof tank, there must be an otherwise untapped reserve of not less than 3,500 gal. This can be obtained in a separate tank or it may be a reserve in the roof tank supplying water to the building for general purposes—the standpipe system being connected to the bottom of the tank and the domestic supply drawn off above the 3,500 gal level. If the system contains more than two standpipe risers, a reserve of 5,000 gal is required—that is if the risers are served by a single tank. If it is divided between two tanks, there must be a reserve of 3,500 gal in each tank. The latter is the better arrangement, as it maintains some available supply, while either tank is being cleaned.

With either of these arrangements, there have been complaints, especially in buildings of residential occupancy, that the presence of these undisturbed reserves (if the tanks are not frequently cleaned) produces stagnancy to a certain extent and an unpleasant taste in the domestic supply. To overcome this, a separate tank of 3,500 gal or 5,000 gal capacity, as the case may be, is provided at the required elevation above the roof, into which all water is pumped directly by the house pumps. The overflow from this tank discharges into the domestic supply tank or tanks located sufficiently below to permit this water flow.

The standpipe system is connected to the bottom of the upper tank, while the domestic supply is drawn from the bottom of the lower tank or tanks, thus avoiding possible stagnancy in the latter. This arrangement also results in a saving in the cost of the tank supports, as only the smaller capacity tank has to be supported at the required 25 ft height. The larger domestic supply tanks need not be elevated to this extent.

Mortimer Freund
Eadie, Freund and Campbell
Consulting Engineers

New York, N. Y.

Bank Building Enclosed in Glass

As construction of the new Fifth Avenue office of the Manufacturers Trust Company in New York City moves forward at a pace gaited to an early fall opening, the interest of architects and engineers has been attracted by arresting departures from customary procedure in several construction features of the building. These include an unusual cantilever application, an exceptionally large area of light, and a building exterior of glass and aluminum. Structural steel has been erected for the five-story building on a plot 100 by 125 feet.

Fifth Avenue passersby have been kept informed of construction progress by Manufacturers Trust Company through bulletins fixed on the fence "for the information of sidewalk superintendents." The bulletins are changed periodically to keep pace with each new phase of construction.

The desire of Manufacturers Trust Company to create a distinctive bank building was the major factor in determining on a five-story structure of far lesser height than many of its towering neighbors. This is reflected in the unique plan that was developed by the architects, Skidmore, Owings & Merrill, drafted by the consulting engineers, Weiskopf & Pickworth, and is now being translated into reality by the contractor, George A. Fuller Co.

For architectural reasons, clear glass exterior walls are used. The exterior glass does not support any part of the structure. It is a curtain that hangs from the roof cantilevers. Because the second floor is set back ten feet from the exterior wall, this permits a 32-foot high expanse of glass running from ground level to the third floor. Panes of half-inch glass measuring as large as 22 by 10 feet and weighing 1,500 pounds each will be used in the installation. The exterior glass of the other floors will be 10 by 9 feet.

Syska & Hennesy, consulting engineers, faced with the building being in effect a display window, integrated the mechanical and electrical systems into the structure so that there is no visible evidence of their existence. Ceilings of the banking areas are, in effect, huge, luminous light sources. They are designed so that, in addition to creating the desired architectural effect, they conceal all the ductwork, heating and plumbing systems.

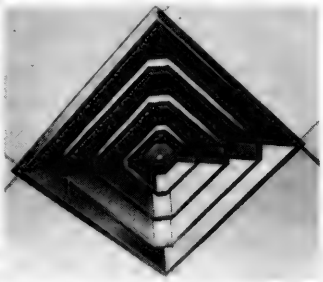
Due to the extensive glass areas, the air conditioning and heating systems are zoned so that movement of the sun is automatically compensated for in maintaining proper temperature.

NEWS OF EQUIPMENT AND MATERIALS

Use the prepaid postcard opposite page 129 for securing additional information on items described in this department.

Square, Rectangular Diffusers

A new series of square and rectangular ceiling diffusers is now available in two styles for installation either on plastered ceilings or for flush mounting in T-bar frame work for acoustical tile ceilings, according to the maker, W. R. Carnes Co., Verona, Wis.



A design feature of these models is a corner air scoop to assure an adequate quantity of air from the corners as well as the sides of the unit, thus giving an even, well-balanced 360° air pattern. Models SFS and SFR have square and rectangular necks and handle from 125 to 6925 cfm. A large variety of neck sizes in both the square and the rectangle are available.

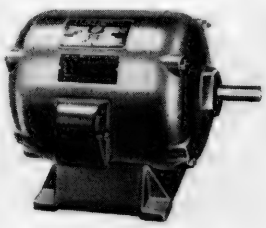
Models RSFS and RSFR have round necks and are available in sizes from 5 through 18 inch and will handle from 50 to 4420 cfm.

A full line of opposed action bladed dampers, splitter dampers, and equalizing deflectors are available for all sizes.

More information? Circle Item 1 on postcard, page 129

Integral Horsepower Motors

A new line of integral horsepower motors, designed specifically to provide smooth, economical changeover to the new standards prescribed by NEMA has been announced by Electric Motor Div., A. O. Smith Corp., Tipp City, Ohio. The company will offer users the new motors in either the present or in new mountings.



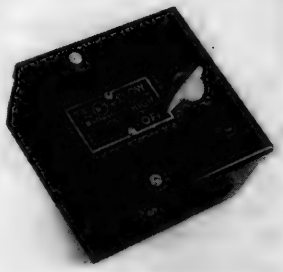
This promises to be a matter of considerable saving to the customer, who during the transition period can avoid the cost of remodeling machines and can liquidate inventories of belts, pulleys and accessories without loss.

Initial production will be in the one, one and one-half (illustrated) and two horsepower ratings. All performance characteristics of the old and new motor lines will be equal. Contour lines and styling will be the same. Only the physical mounting dimensions will vary according to the customers' wishes.

More information? Circle Item 2 on postcard, page 129

Small Motor Speed Control

Its newly-developed speed control for fractional horsepower shaded pole motors is added to the line of The Ballastran Corp., Fort Wayne, Ind. The control can be made for three-speed operation, and features an air gap design which assures starting at low voltages and eliminates core saturation, the cause of heating, current distortion, and reduced motor torque.



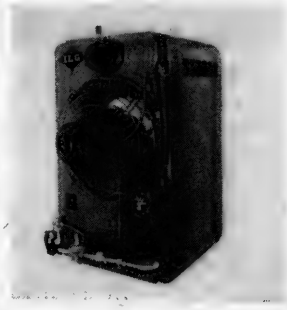
Three models are available: (1) cased control, for remote control installations, with the control reactor and switch mounted in an outlet box for permanent installations. Knock-out holes are provided for wiring. (2) panel mounted control, to permit single hole mounting on panels for convenience in certain applications. (3) chassis mounted control, for jobs where it is desirable to mount the control reactor within the fan base or blower enclosure. Lead length can be provided to suit any application, and the size of the control varied to fit the enclosure.

In view of possible variations of motor types, applications and speed requirements, the controls are designed for each specific application. Furnished information should include: motor voltage, current and watts at reduced speed, preferred model, and overall dimensions.

More information? Circle Item 3 on postcard, page 129

Seven Gas Unit Heaters

A new line of automatic gas fired unit heaters to provide low cost, efficient space heating for a wide variety of commercial and industrial installations, is introduced by Ilg Electric Ventilating Co., Chicago, Ill. The new line will be marketed under the trade name Ilgdualgas.



Each of the seven new models can be used with natural, manufactured, mixed, propane or butane gas which permits installations in virtually any location. They carry the approval of the American Gas Association and Underwriters' Laboratories to meet building code and fire department regulations.

Capacities range from 25,000 Btu per hour with a maximum throw of 18 feet, to 200,000 Btu per hour with a throw of 56 feet. Burners are the raised port type to eliminate flash backs and reduce noise. The combustion chamber is heavy gage, welded steel with a built-in draft diverter.

Bulletin 285 is available.

More information? Circle Item 4 on postcard, page 129

Fuel Oil Conditioner

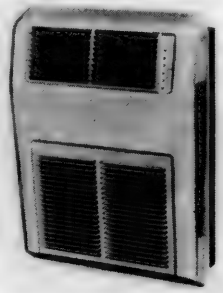
A fuel oil conditioner, specially formulated to act as a solvent of the sludge formed in modern catalytic cracked fuel oils, Pet-Re-Nol, is being manufactured by Norman Chemical Co., St. Paul, Minn.

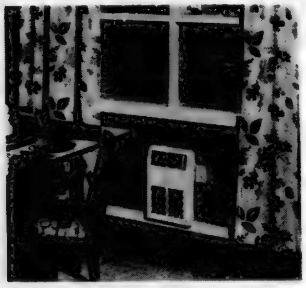
It is claimed also to dissolve the gummy binder that holds sludge together; disperse insoluble particles of sludge and insure their being burned; prevent corrosion; provide better fuel atomization; and absorb water, which, through water-gas reaction, will remove carbon from the burner tips.

More information? Circle Item 5 on postcard, page 129

Turbine Drive Heating System

Its new SelecTemp heating system which features a thermostat in every room and continuous circulation of filtered warm air, has been released by Iron Fireman Mfg. Co., Cleveland, Ohio. Steam generated by a low pressure steam boiler is conducted through small copper tubing to the compact individual room units, which are normally recessed into the outer walls, leaving only the outer grille extending beyond the surface of the wall. Output capacities of the three sizes of units are 6,000, 12,000 and 18,000 Btu per hour.





Each heater is a fully automatic unit, consisting of a copper heat exchanger, steam turbine driven fan for circulating room air through the unit, air filter, and a self-contained non-electric thermostat.

The sensitive thermostat in each room unit continuously modulates the flow of heat as required accurately to maintain the temperature selected.

When mounted on an outside wall, the units will automatically increase the indoor air temperature as the outdoor air temperature decreases.

According to the manufacturer, the system provides modulated zone heating in such a simple, practical manner that individual room temperature selection is practical for all heating applications.

The modern home with its extended floor plan, and large picture windows, definitely requires more than a single thermostat to provide comfortable temperatures, the manufacturer states, especially since in any home or any building different people require different degrees of warmth for the greatest comfort.

During the past four years a large number of installations of the system has been made in all types of homes and commercial buildings and there are now several thousand units in service.

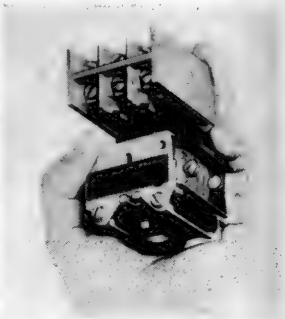
Under normal operation, the thermostat modulates the flow of heat from 1/20 of capacity to full capacity. Thermostat controls both steam supply and speed of the fan to exactly meet heating requirements. Thermostat setting range is from 40 to 90 deg. F.

No electricity is required to operate circulating fans, and thermostats are non-electric, eliminating wiring. No other system can be so easily installed in either new or old buildings. The small flexible copper tubing which carries steam to units and returns condensate is economical to install.

More information? Circle Item 6 on postcard, page 129

Compact Magnetic Contactor

Small enough to fit the palm of the hand, yet rated up to 5 hp at 208-550 volts, the Little Giant magnetic contactor is announced by Furnas Electric Co., Batavia, Ill. Furnished in 2, 3 or 4 poles, the contactors feature small size, light weight, easy access to coils and contacts plus simplicity of construction.

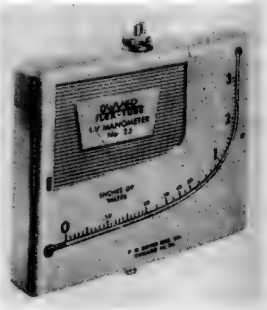


Wide contact gap, 21/64 inch, is especially advantageous in reversing contactors to avoid flashover during rapid reverses. Already incorporated in air conditioning and heating units, the contactors are adaptable to applications requiring a compact magnetic switch for intermittent or continuous duty.

More information? Circle Item 7 on postcard, page 129

Versatile Gage, Plastic Housed

An unusually versatile gage for plus, minus and differential readings is announced by F. W. Dwyer Mfg. Co., Chicago, Ill. It is claimed that the new I-V gage will serve as air filter gage, static pressure indicator, draft gage, or air velocity meter.



The gage is equipped with a plunger type oil level adjuster, and has ranges of 0 to 3 inches and 0 to 7 inches of water, and a low range accuracy of .01 inch water. It is also available in a direct reading velocity model for use with a pitot tube, ranges 0 to 7,000 and 0 to 10,500.

Furnished complete with tubing and fittings, this new gage is housed in an attractive, rugged molded plastic housing.

More information? Circle Item 8 on postcard, page 129

Submersible Sump Pump

Designed for portable or stationary service, an automatic electric submersible sump pump with 1¼ inch discharge, a capacity of 2200 gph at a discharge head of 10 ft. and 400 gph at 24 ft. head, has been placed on the market by Penberthy Injector Co., Detroit, Mich. It operates on continuous or intermittent duty, and features positive priming without venting. It is 12½ inches high, occupies a 10 inch diameter space and weighs 40 lb.

The 1/3 hp. motor is specifically designed for submergence duty and provided with built in overload protection, grease sealed permanently lubricated ball bearings, with combination carbon-ceramic rotary shaft seal. A 12 ft. waterproof heavy duty cord with ground wire is provided.

While automatic starting and stopping levels are 8 in. and 2 in. above sump bottom, by simply removing top electrode tip, the automatic starting level is increased to 20 inches, a desirable feature when the pump has to operate too often (not more than once per minute recommended). Manual starting is also provided by momentary contact switch, with automatic stopping not affected. This is desirable when the pump is used as a portable unit.

More information? Circle Item 9 on postcard, page 129

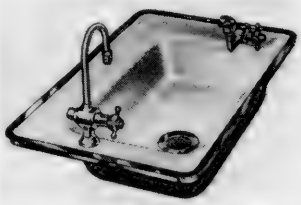
Acid, Salt Resistant Joint

A solvent, acid, alkali and salt resistant joint suitable for waste lines in chemical process plants, is introduced by Atlas Mineral Products Co., Merztown, Pa. This combination joint will withstand hot corrosive effluents which will attack almost all previously known jointing materials.

More information? Circle Item 10 on postcard, page 129

School Drinking Fountain

The Series 2000 deck type drinking fountain, designed to fill the varying requirements of school classrooms, is a new product of Haws Drinking Faucet Co., Berkeley, Calif. The drinking fountain consists of a sturdy cast iron receptor which can be used with virtually any combination of Haws fixtures, including bubbler type drinking faucets, pantry faucets, fill glass faucets, double pantry type faucets for hot and cold water, or the Model 8926 emergency eye-wash fountain.



Available in white or matching color acid resisting enamel finish, the receptor itself is equipped with a Hudee type raised and sloped stainless steel mounting rim that provides a water tight installation between sink and cabinet top and prevents water running back onto the deck. Normally drilled for two fixtures, one on each end, with vandal-proof socket flanges and lugs that prevent fixtures being turned, the unit also may be had with only one fixture or a third fixture on back, on special order.

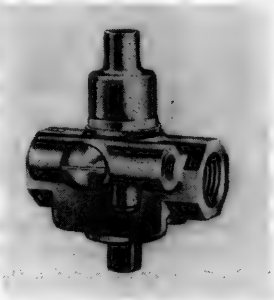
The faucet is also highly suitable for school laboratories, where it is often desirable to provide a drinking water source along with a receptor suitable for routine laboratory use. Many demands of commerce and industry for a drinking water source combined with cleansing facilities can also be answered by the unit.

More information? Circle Item 11 on postcard, page 129

Manual Reset Pilot Valves

A series of new compact manual reset thermopilot valves for gas-fired appliances, providing automatic gas shutoff upon pilot flame failure, is in production by General Controls Co., Glendale, Calif.

The newly-developed valves, which operate on the thermocouple principle and so require no outside electrical source, are for use with all gases including LPG and sour gas, and have a 100% shutoff feature.



Both a non-flow interrupter type, designated as the MR-3 valve, and a flow interrupter type, labeled MR-4, have been designed to broaden the application of the series. Models of either type are available with or without pilot takeoff, or with an independent auxiliary valve for separate pilot gas flow. The auxiliary valve maintains the full gas shutoff advantage and permits installation of the thermopilot valve downstream from the main shutoff or automatic valve.

On flow interrupter models, depressing the reset button opens the pilot valve only, permitting the flow of gas to the pilot. Lighting the pilot and releasing the button frees the main valve and permits movement of gas to the main burner.

The new units accept standard tube and pipe sizes, including ½ inch. Their application covers all gas-fired appliances, such as room heaters and boilers, which do not require additional safety or limit controls in the self-generating electrical system.

The MR-3 and MR-4 series are further designed to utilize a wide selection of pilot burners and thermocouple combinations, among which is the PC pilot-couple with the thermocouple tip welded into the pilot burner head, permitting the new device to operate under adverse field conditions. Its exclusive one-piece construction assures that a constant source of heat is transmitted to the thermocouple regardless of draft conditions.

If lint and dust are factors these valves may be used with the company's type 2600F thermocouples and the new snorkel incinerator type pilot burner. This new snorkel pilot burner assures completely dirt free primary air and reduces service problems.

More information? Circle Item 12 on postcard, page 129

Remote Reading Tank Gage

The Keco remote-reading tank gage, for use with vented fuel oil, gasoline and diesel oil tanks to 9 ft. depth, is a new product of King Engrg. Corp., Ann Arbor, Mich.

This gage shows the depth of fuel in inches, and is designed for use in commercial buildings, institutions, or wherever quick gaging is desired without going near the tank. It can be located near the furnace or wherever most convenient, at any reasonable distance from the tank, and at any desired elevation.

The etched-aluminum scale plate has four different scales, to permit using the gage with fuels of a wide range of API gravities. Only one scale is visible at any time. If the grade of fuel is changed, the scale plate is readily turned to bring the proper scale into reading position. It is not necessary for the dealer to carry a stock of scales for various fuels or order a special scale for each installation.

The gage works as a frictionless hydrostatic balance, and has no moving mechanical parts except a small air pump built into the case. The case is of molded nylon, and cannot chip or corrode. All parts in the tank are steel, not affected by sulfur or other chemicals in the fuel.

Installation consists only of mounting a ½-inch pipe in the tank, placing the gage on a wall or column, and connecting a ¼-inch copper tube from the tank to the gage. The gage is 8½ inches high x 2¼ inches x 2¼ inches over all.

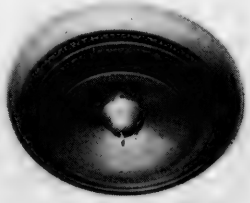
Bulletin 375 is available.

More information? Circle Item 13 on postcard, page 129

Round, Square Air Diffusers

A comprehensive line of round and square air diffusers is announced by Air Fan Engineering Co., Los Angeles, Calif.

The round diffuser is made for both low and high velocity air and is fabricated of two or three spun conical discs. An adjusting device makes it possible to vary the air delivery from zero to flow output, with three positive controls of air through air mixture and air movement.



The 4-way square diffuser is built to take the main air stream and divide it into layers one flowing beneath the other at the proper angle of discharge to obtain maximum air flow, air mixture, and air movement in the room.

The round outlets are made in 9 sizes, ranging from 8 to 36 inches in diameter. The square diffusers are made in 14 sizes ranging from 10 to 36 inches in increments of 2 inches.

More information? Circle Item 14 on postcard, page 129

Tool Digs Sewer Lines

Time required to tunnel for sewer line installations has been reduced 75% in Los Angeles by use of the Super Hole-A-Matic digging and tunneling machine made by Multi-Matic Corp., Van Nuys, Calif. Tool digs easily at any angle, requires only one man to operate and, with shaft extension, will drill 15 feet or more, making it ideal for contractors.

The Los Angeles sewer line installation required the drilling of holes approximately 8 inches in diameter and 12 feet across, connecting a series of trenches 12-feet deep. Although the operator had a working space just two feet in width, connecting holes were dug in 25% of the time ordinarily required. The tool went through the mucky clay easily with just one man on the job. Normally two men are required for this type excavation.

More information? Circle Item 15 on postcard, page 129

Metal-Ceramic Thermocouple Well

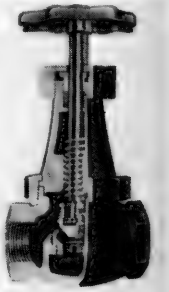
A new thermocouple protection tube combining the thermal conductivity and shock resistance of metal with the oxidation and deformation resistance of ceramics is announced by The Bristol Co., Waterbury, Conn. The new Metal-Ceramic LT-1 thermocouple well has a wall thickness of only ⅛ inch, so that time lags in temperature response are drastically reduced. The material itself has a thermal conductivity about the same as cast iron.

Available in lengths of 12, 18, and 24 inches, the metal-ceramic well can also be supplied in a complete thermocouple assembly.

More information? Circle Item 16 on postcard, page 129

Valve Cuts Down Time

Re-christened Gyroseal, a new and improved version of the company's Ostlind valve is being produced by Richmond Foundry and Mfg. Co., Richmond, Va. These valves eliminate the causes of valve failure by causing the disc to rotate rapidly at the moment of closure. Foreign particles are thrown off by centrifugal force and the turbulence created keeps the particles in suspension while the disc is gently polished against the seat.



Stronger yet simpler in construction than the original valves having this feature, the valves last longer, need less repair and are simple to repack. They cut down-time by eliminating leakage, unbalanced flow, spalling, wire drawing, chattering, sticking and the necessity for regrinding or replacing disc and seat.

More information? Circle Item 17 on postcard, page 129

Start and Overload Switch

A manual starting and overload switch for fractional horsepower motors is announced by General Electric Co., Appliance Control Dept., Schenectady, N. Y.

Essentially a start-stop switch with manual reset overload, the new unit was designed to control small motors where line current overload protection is required. The device was developed for use on appliances. It is totally enclosed to help protect it against environmental conditions.

Protection against overload is provided during both starting and running through the use of a nichrome heater and a nickel-alloy bimetal strip in the tripping mechanism. Depressing the start button during overload will not re-energize the motor until the overload condition is removed and the bimetallic strip returns to normal position.

More information? Circle Item 18 on postcard, page 129

Aluminum Coating for Ducts, Tanks

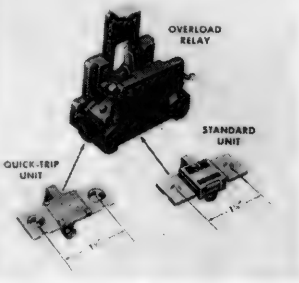
Development of a new material which makes it possible to metalize surfaces with aluminum, without the use of heat, is announced by Emjay Maintenance Engineers, Rutherford, N. J. The process is based on a material called Kolmetal, a mixture of finely pulverized aluminum in a plastic base. The resultant coating, achieved by two applications of Kolmetal with a four hour drying time between applications, air-hardens to a plastic bonded aluminum surface which can be polished, ground, drilled or bent to a 45 degree angle without chipping or cracking.

The material is recommended as a coating for the interiors of all types of tanks, both to prevent the contents from contamination and to protect the interior from corrosive action of the contained liquid. It proves an excellent exterior coating for acid cooling coils since it has practically no insulating effect, and is reported as ideal for protection of ducts and piping.

More information? Circle Item 19 on postcard, page 129

Overload Unit for Hermetic Units

A new quick-trip overload thermal unit for protecting hermetically sealed compressor motors, is announced by Square D Co., Milwaukee, Wis. Shown with the overload relay (top view) is the Type FB quick-trip unit (lower left) which trips in approximately one-third the time required by the Type B standard unit (lower right).



In addition to short trip time and dependable repeat protection, an important feature is interchangeability. The thermal element used is a separate factory calibrated unit and is not an integral part of the overload relay block. Starters and unified control panels can be stocked without thermal units, minimizing inventory. When starter or control panel is installed, correct thermal unit to match compressor size can quickly and easily be assembled from front.

More information? Circle Item 20 on postcard, page 129

Twin Units for Year Round Use

A new combination winter and summer air conditioner, known as the Win-Sum Twins, a combination of a gas-fired winter air conditioner and a new summer air conditioner, is announced by Janitrol Div., Surface Combustion Corp., Toledo, Ohio.

The units use the same duct system and a damper control permits only one of the units to operate at a time. The summer air conditioner can be added to old or new forced air furnaces at any time, allowing installation of the winter air conditioner immediately and the summer unit at a later date.

Three models are offered in the summer air conditioner line. The 5-ton cooling capacity unit is a unique combination of the 2 and 3-ton capacity units. This permits economical operation of just the 2-ton unit for dehumidification purposes before peak temperatures necessitate maximum operation of both 2 and 3-ton units.

None of the units in the summer conditioner line requires more floor space than the average refrigerator. All use a hermetically sealed, warranteed compressor placed in the cabinet to permit easy replacement if necessary.

More information? Circle Item 21 on postcard, page 129

Moisture Separator

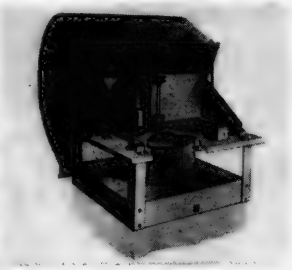
A separator for use in horizontal steam, air and gas lines is announced by Wright-Austin Co., Detroit, Mich. The new device, identified as the 31-N separator, is a refinement of the company's 30-N type separator, used widely in various industries. It installs in minimum space, occupying scarcely more space than the section of pipe it replaces. It is self-cleaning and may be used with a wide range of pressures. Construction is fabricated steel.

The proven centrifugal force principal is applied in the new separator for removing entrainment, including water, oil and solids from the pressure line delivering a clean flow to the equipment.

More information? Circle Item 22 on postcard, page 129

Fan Type Ventilator

Mechanical improvements and complete redesigning of its Airlift centrifugal fan ventilator are announced by The Swartwout Co., Cleveland, Ohio.



A new one-section hood, lifting on swing-hinges in smaller models and removable on large sizes, covers motor chamber and directs air exhaust downward for dispersion over roof. Removal of the hood provides easy access to motor and fan chambers for servicing and cleaning.

Designed primarily for low noise level duct exhaust, the ventilator is cataloged in 14 sizes and a wide range of available capacities at static pressures from 0 to 7/8 inch. Capacities are certified to have been determined in accordance with the test code adopted by NAFM and ASHVE.

Bulletin AL-2 is available.

More information? Circle Item 23 on postcard, page 129

20 In. Offset Fan Blade

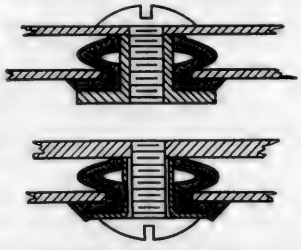
Development of a 20-inch offset fan blade designed to reduce the required thickness of assembled air-moving appliances by curling back around a motor, instead of protruding out from its motor shaft, is announced by The Torrington Mfg. Co., Torrington, Conn. The new fan blades are particularly adapted to use in more compact models of direct drive window ventilators.

The new product, designated the AIRistocrat YO-20-inch offset fan, has a center dimension opening of 6 3/8 inch diameter and was designed to accommodate all known conventional motors suitable for this type of operation.

More information? Circle Item 24 on postcard, page 129

Small Motor Isolators

Low cost, ease of installation, and effective isolation of noise and high-frequency vibration, are features of the new T-nut isolators developed and manufactured by the Barry Corp., Watertown, Mass. These units are typically used to quiet small motors, to isolate sensitive assemblies, to protect panel-mounted instruments, and to reduce transformer hum. With a natural frequency of 35 to 40 cps, they provide excellent isolation of disturbing vibrations at 100 cps and above.



The method of use, including blind wall installation, is indicated in the drawings. The T-nuts will fit through plates up to 3/16 inch thick in four core lengths. Only 1/16 to 1/8 inch clearance is needed between the isolated assembly or unit and the mounting panel. The core is either clearance-drilled, or tapped for any of several common machine-screw threads. The resilient material is either rubber, GRS, or neoprene.

More information? Circle Item 25 on postcard, page 129

40,000 Btu Gas Unit Heater

A new Humphrey gas unit heater is announced by General Gas Light Co., Kalamazoo, Mich. It is a heater of moderate capacity and economical cost.

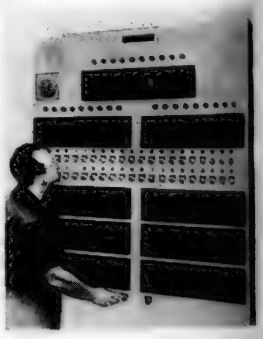
The 40G unit heater has an input rating of 40,000 Btu per hour and incorporates a number of features including new type six flue heat exchanger of high tensile alloy steel, assuring long life; universal type burners; tilting louver front; stainless steel, dust free pilot; positive, dependable safety controls; rear vent permitting close to ceiling installation —approved for six inch top and side clearance, and built-in fan and limit control and summer fan switch.

More information? Circle Item 26 on postcard, page 129

Alarm Shows Cause of Shutdown

A new type of annunciator system which automatically indicates the sequence of off-normal alarms is announced by Panalarm Products, Inc., Chicago, Ill.

The annunciators are desirable where alarms are applied to closely inter-related variables. In most of these applications, if any one of the variables goes off-normal, the process shuts down. Thus, with conventional annunciators it would be difficult to determine which variable first went off-normal and caused the shut-down.



Sequence indicating annunciators pinpoint the cause of trouble by indicating the first variable to go off-normal. This is accomplished either by automatic lock-out of subsequent signals, or by causing the first signal to be red and subsequent signals white. A pushbutton reset feature is also available which causes the sequence indication to start over again.

In addition to use in compressors and process applications where the cause of trouble is sought, sequential annunciators are also advantageous on dangerous processes where operators want to be sure the entire process has shut down when trouble occurs.

Visual sequence annunciator systems are available in standard backlighted nameplate cabinets providing from 3 to 48 signals.

More information? Circle Item 27 on postcard, page 129

(*Continued on page* 122)

"OVER 10,000 Satisfied Maryland Home Owners Attest to the Outstanding Qualities of REVERE COPPER WATER TUBE—"

Says, Anthony W. Keene, President, ANTHONY W. KEENE, INC., Heating & Plumbing Contractors, Baltimore, Md.

"I've been operating in the Baltimore area for over eighteen years," said Mr. Keene. "Typical of the 10,000 units in which I have installed Revere Copper Water Tube is the Meadow Lane development which you see on the wall of my office. I have worked with various builders and they have told me they wouldn't specify anything but enduring copper water tube for plumbing lines . . . no rustable materials for them. Not only that; copper is easy to bend, needs no threaded fittings so naturally we can hold down our installation costs. Ever since I have been in business I have used Revere Copper Water Tube and have never regretted one foot of it."

Keep out of trouble with copper . . . guard *your* reputation for quality work. Use enduring Revere Copper Water Tube. There's a Revere Distributor near you who carries a full stock in both hard and soft tempers. And, if you have technical problems, he will put you in touch with Revere's Technical Advisory Service.

REVERE

COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

230 Park Avenue, New York 17, N. Y.

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Mills: Baltimore, Md.; Chicago and Clinton, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Rome, N. Y.— Sales Offices in Principal Cities, Distributors Everywhere

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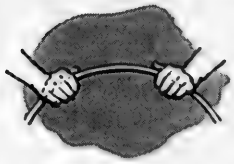
WHY REVERE COPPER WATER TUBE IS PREFERRED BY—

Architects, Builders, Plumbing & Heating Contractors



EASY TO BEND

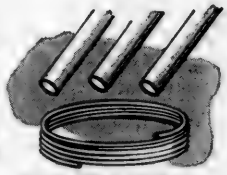
Saves Time

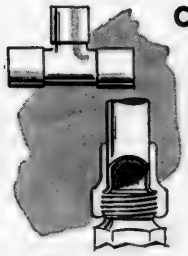
Revere Copper Water Tube is easy to bend. Soft temper can be bent by hand to meet installation conditions.

HANDY LENGTHS

Save Fittings . . . Labor

Revere Copper Water Tube comes in straight lengths of 20′ in hard and soft tempers. 60′ coils of soft temper reduce the number of fittings needed.





SOLDER OR COMPRESSION FITTINGS

Need Less Work Room . . . Save Metal

No worry about wrench room when you use Revere Copper Water Tube with solder fittings. Compression fittings can also be used. No threading is necessary with either type fitting. Wall thickness of tube used can thus be less than for threaded pipe.

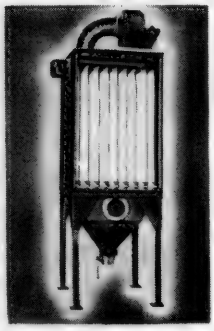
NON-RUSTING

Rustable pipe eventually clogs as shown in drawing at top right. Non-rustable Revere Copper Water Tube suffers no loss of flow or pressure as shown at bottom right. No allowance in pipe size need be made for rust accumulation with Revere Copper Water Tube.

(*Continued from page* 120)

Unit Type Dust Collector

The Type CN cloth bag dust collector, designed for dust collection for smaller volume applications, is announced by Pangborn Corp., Hagerstown, Md. Each unit is self contained and shipped assembled ready for installation.



This collector is designed for indoor use and cleaned air can frequently be discharged inside the plant, a saving where air is heated or cooled. Finely divided dusts such as carbon black, cork, fine wood, graphite, pigments, lime, lamp black, soap, fine tobacco and metal oxides, are collected through cloth filter bags similar to the company's large Type CM collector.

Dust laden air enters the collector where it is expanded in a settling chamber. Here, the reduction in velocity drops coarser dust particles directly into the hopper. A baffle plate prevents the air from rising immediately to the cloth bags, and therefore the only escape for air is through the open bottom of the bags. This air then flows into the bags where the fine dust particles are filtered on the bags' inner surfaces. Cleaned air passes through the bags and is discharged from the collector.

Seven sizes are available, ranging from 200 to 1,000 sq ft of cloth area. Sizes 200 to 500, inclusive, have one hopper and nine bags. Width and depth are constant, additional capacity being supplied by lengthening the bag. Sizes 600, 800 and 1,000 are double sections of the 300, 400 and 500 sizes, featuring two hoppers and 18 bags, but only one air inlet and one settling chamber.

More information? Circle Item 28 on postcard, page 129

Polyvinyl Chloride Pipe Fittings

Injection Molded fittings of rigid polyvinyl chloride threaded pipe fittings in sizes ranging from ½ to 2 inches O.D. are available from Thermoplastic Structures Div., Atlas Mineral Products Co., Mertztown, Pa. These fittings are more uniform, stronger and more economical than previously available transfer molded fittings.

More information? Circle Item 29 on postcard, page 129

Noiseless Duct Connection

A flexible duct connection that abolishes vibration noise, the Silent Duct, is announced by Elgen Mfg. Corp., Long Island City, N. Y. The feature is that the metal and material are factory-assembled into a single unit, thus saving sheet metal workers the time and expense of doing their own assembling. It is reported that its use saves up to 60% of the cost of fabricating flexible duct connections.

The connection is delivered in 100-foot coils, each coil being in a rugged carton which serves as a handy dispenser. The duct lies perfectly flat, ready to cut, bend and seam.

The duct is made of 24-gage galvanized steel, permanently fastened to canvas that is fire, water and mildew resistant. It is also available with heavy, top quality, non-porous asbestos.

More information? Circle Item 30 on postcard, page 129

Casement Window Cooler

Details of an air conditioner designed for casement windows are revealed by Airtemp Div., Chrysler Corp., Dayton, Ohio. This attractive ½ hp window unit is expected to open up a market of two and a half million new homes and offices constructed with casement windows since 1946.

The new product is most compact, and is one of the few that are entirely enclosed within the room.

Developed in co-operation with the American Window Institute, the air conditioner fits standard-size casement sashes. It is securely bolted to the frame using the same openings provided for storm windows and screens.

It is finished in a London beige enamel. The air conditioner's metal cabinet is easily removable without dismounting. The molded plastic air discharge grille features movable vanes for directing the air flow up, down or to either side. Controls are hidden under an attractive plastic cover at the front of the unit.

The conditioner is quickly installed from within the room. Thermostatic control and two-speed fan are standard equipment.

More information? Circle Item 31 on postcard, page 129

Room Unit Thermostat

A thermostat for room heaters and conditioners is now being manufactured by Westinghouse Electric Corp., Pittsburgh, Pa. Called the Room-Temp thermostat, it can be used to control air blast heaters, unit heaters, radiant heat panels, furnaces or air conditioners.

One of the features of the new model is its ability to handle currents as high as 30 amps, 125/250 volts, without a circuit relay or contactor.

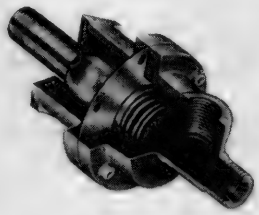
It can be mounted on the appliance chassis with one or more rivets or screws and has easily accessible terminals for simplified wiring. Positive snap-action to eliminate interference in radio and television reception combined with extremely sensitive bi-metal temperature response at a narrow differential make an accurate and desirable control.

The thermostat is available with a single pole, single throw, or single pole, double throw.

More information? Circle Item 32 on postcard, page 129

2 Types of Rotary Joints

A new type packless and leakproof rotary joint, operating on the ball-and-socket principle, and manufactured in two types, is announced by Key Co., East St. Louis, Ill., which has been appointed distributor by the manufacturers, Phillips Rotary Joint and Valve Corp., West New York, N. J.



The Thru-Flo type is a single inlet unit designed to transfer liquids or steam into or out of any revolving drum. The siphon type (illustrated), is designed for installations where inlet and outlet is desired in the same unit, or for siphon drainage of condensate from the steam chambers of a roll or drum.

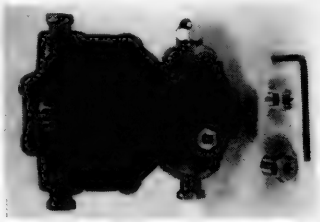
The joints are designed for high efficiency, long life and economy on all services on which they are to be used. They can be used in both high and low pressure installations.

More information? Circle Item 33 on postcard, page 129

Fuel Unit Bleeder Valves

New improved ⅛ and ¼ inch bleeder valves for oil burner fuel-units and other low pressure hydraulic equipment has been introduced by Hydrovalve Co., Brooklyn, N. Y.

When used as an air bleeder valve on a fuel unit, it gives the serviceman an added advantage. In order to purge a dry fuel-unit, with an Allen wrench, simply loosen the socket set screw, until all air is expelled and there is a steady flow of oil.



These bleeder valves are made of extruded brass, feature dryseal pipe threads, alloy socket screws, and an exclusive undercut internal thread which allows an indefinite amount of opening and closing without fear of ever leaking.

The valves are now available as standard equipment on many popular fuel-units and oil burners.

More information? Circle Item 34 on postcard, page 129

Meters Steam for Heating

An engineered equipment package that makes possible the measurement of steam under widely different load conditions, is announcd by Builders-Providence, Inc., Providence, R. I., in conjunction with C. E. Squires Co., Cleveland, Ohio. The principle involved is the division of flow from a high range to a low range Shuntflo meter, whenever the demand on the system is low, by means of a compact changeover arrangement.

A typical installation of this unique dual range metering system is now in use by a mid-west heating company. An application bulletin, available from the manufacturers, contains a schematic installation diagram, a complete description of the equipment used and its application, and cites the following advantages: Provides means for metering over a much wider range than any single step meter; increases annual revenue; prevents overload and subsequent damage to low range meter; eliminates need for condensate meter with return lines and attendant maintenance problems, and eliminates need for changing meter orifices. Application bulletin K19 is available.

More information? Circle Item 35 on postcard, page 129

High-Low Velocity 1 in. Filter

Announcement of a new, long-lasting 1 inch thick air filter, efficient in both high and low velocity air-conditioning systems and holds up to 800 grams of standardized fine air cleaner test dust between cleanings, is announced by Farr Co., Los Angeles, Calif. Sustained performance is maintained with low pressure loss.

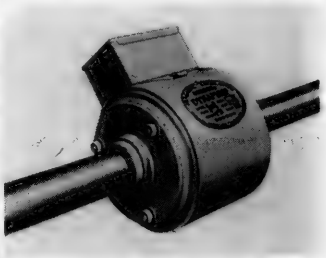
The new filter operates efficiently between 800 and 1200 cfm per 20 x 20 inch panel, thus making it applicable to either high or low velocity installations. When the filter is operated at the higher velocity, the face area can be reduced to as little as two-thirds that required for other types. Available in practically any size, it fits filter bank installations designed for 1 inch thick units.

Performance of the filter is due to the advanced type of media used in its construction. The herringbone-crimp screen characteristics of other Far-Air units have been modified by adding a gabled-crimp design to produce maximum efficiency with minimum thickness. It loads progressively without critical pressure loss, is easy to clean and has a long service life.

More information? Circle Item 36 on postcard, page 129

Magnetic Type Circulator

A new type of magnetic pump for circulator applications has been announced by The Fostoria Pressed Steel Corp., Fostoria, Ohio.



Known as the Dynapump, this new circulator is said to be exceptionally quiet and has no shaft seal or motor bearings to require service. Compact and light in weight, the unit gives heads of 24 feet, making it particularly adaptable for radiant and baseboard heating jobs.

Since all pump parts are of corrosion-eliminating stainless steel, it is suitable for either fresh or closed water system. The one standard unit accepts interchangeable flanges from ¾ to 1½ inches and carries a two-year warranty.

More information? Circle Item 37 on postcard, page 129

(*Continued on page* 126)

How Honeywell Customized Temperature Control can help you

Give your clients control of their own "indoor weather"

Why Honeywell Customized Temperature Control is becoming a building "must"

New home of the Daytona Beach Federal Savings and Loan Association, Daytona Beach, Florida. Architects and engineers: Bank Building and Equipment Corporation of America, St. Louis. Heating contractor: D. W. Browning Plumbing and Heating, Daytona Beach, Florida.

MORE and more, clients are becoming increasingly aware of how comfortable buildings help attract better personnel, help keep customers happy.

Today the best way to provide year around comfort is through the use of *Honeywell Customized Temperature Control.*

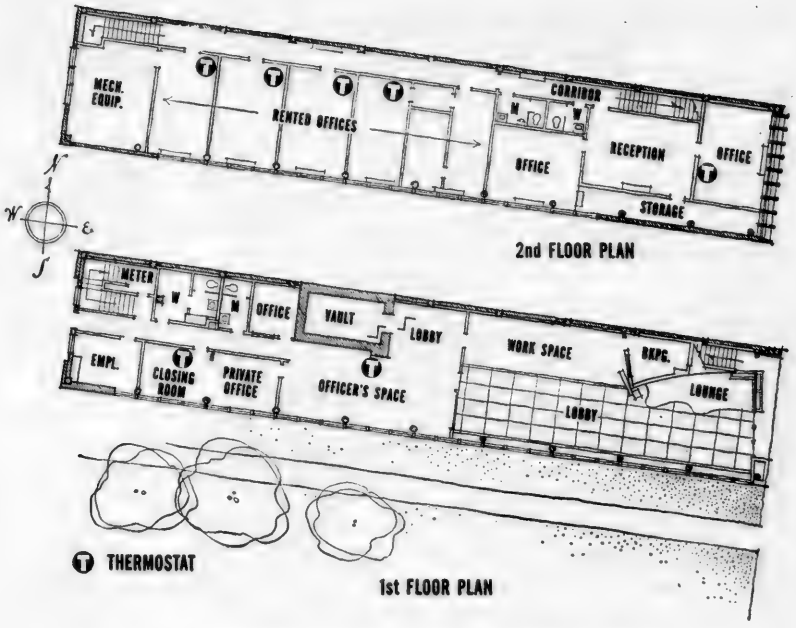
The key word here is "customized." It means that whatever your clients' control requirements, a Honeywell Customized Temperature Control installation *designed to fit the needs of the building and its occupants is your answer.*

Only Honeywell can provide "customized" control. Because only Honeywell makes all three types of controls—pneumatic, electric and electronic, for heating and cooling, ventilating and humidity.

The story, in brief form, of the Honeywell Customized Temperature Control installation in the Daytona Beach Federal Savings and Loan Association Building in Daytona Beach, Florida, is told here. The *techniques* used, applied to your particular problems, can help you give your clients the "indoor weather" they've always wanted.

This reception room is typical of the modern design of the entire building. Modern design includes "indoor weather" control provided by Honeywell Customized Temperature Control. On the second floor, individual thermostats in each of the office spaces make it possible for tenants to maintain the "indoor weather" at the level *they* prefer.

Thermostats on the main floor guard against overheating by solar radiation through the large exposure of glass which faces south. Main floor thermostats of the Honeywell Customized Temperature Control installation do another job too: they give the proper degree of heating or cooling in the more enclosed spaces at the rear.



For comfortable, even temperature in new or existing buildings—of any size—use Honeywell Customized Temperature Control

WHETHER it's a bank, office, motel, airport, hospital, apartment, church, school, factory, store, garage—or any size building—new or existing, Honeywell Customized Temperature Control can help meet your clients' heating, ventilating, air conditioning and industrial control problems.

Your clients will not only enjoy more comfort and efficiency than they've ever known, they'll save fuel, too.

For full facts on Honeywell Customized Temperature Control, call your local Honeywell office. Or mail the coupon below.

L. E. Northrup, executive vice-president of the Daytona Beach Federal Savings and Loan Association, says:

"It is our belief that our new building offers the finest service and facilities for miles around. Important in helping us provide just that is our Honeywell Customized Temperature Control installation."

MINNEAPOLIS
Honeywell

104 OFFICES
ACROSS THE NATION

H HONEYWELL

First in Controls

MINNEAPOLIS-HONEYWELL REGULATOR CO.
Dept. HV-2-31, Minneapolis 8, Minnesota

Gentlemen:
I'm interested in learning more about Honeywell Customized Temperature Control.

Name.....

Firm Name.....

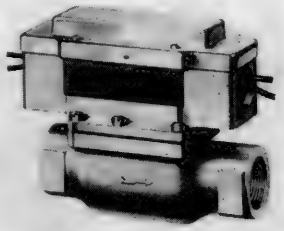
Address.....

City.....*Zone*.....*State*.....

(*Continued from page* 123)

New Main Control Valve

A new main gas control valve is introduced by Milwaukee Gas Specialty Co., Milwaukee, Wis. Using a rotor operating in a magnetic field instead of the usual solenoid, this new control, called the Actrol valve, eliminates noise.



The first model offered is a low voltage model in the ¾ inch size. It has a capacity of 170,000 Btu per hr with manufactured gas and 252,000 Btu per hr with natural gas.

Characteristics of this valve are such that the greatest force is exerted at the beginning of the stroke when the valve must open against gas pressure, so that this new valve has less tendency to stick. The valve closes against a synthetic rubber seat, another contribution to silence.

Installation of the valve is simple, since the transformer is built into the control, and can be turned end for end to facilitate wiring. The transformer is readily replaceable. A further aid to installation is the fact that the valve body can be mounted in any desired position through 360° around the centerline of the valve.

More information? Circle Item 38 on postcard, page 129

Solubility of Freon in Water

Solubility of Freon fluorinated hydrocarbon compounds in water depends upon the pressure, temperature, and the number of fluorine atoms in the compound, according to Kinetic Chemicals Div., E. I. du Pont de Nemours & Co., Wilmington, N. J., in reporting on a two-year research project for the refrigeration industry.

Increases in pressure result in a nearly proportional increase in the amount of Freon dissolved, the report showed, but solubility decreases as the temperature rises. For Freon compounds having the same number of carbon atoms, solubility also decreases as fluorine is substituted for either hydrogen or chlorine in the molecule. Included in the research study were Freon 12, 13, 14, 22, 23 and 115.

Of the compounds studied, Freon-12 and 22 are used widely today as refrigerants in cooling equipment.

In general, it was found that the different types of Freon have limited solubility in water. This fact should be of particular interest in the refrigeration and air-conditioning field where Freon refrigerants are used in liquid chilling equipment or are being considered for use in absorption type equipment.

Solubilities of the various compounds varied from 0.026 pounds per gallon of water at 14.7 pounds per square inch absolute pressure and 77 deg. F., in the case Freon-22 to 0.0002 pounds per gallon under the same conditions with Freon-14. Solubility of the compounds, it was found, decreased with increasing temperature when the pressure was held constant.

More information? Circle Item 39 on postcard, page 129

Spray Room Exhaust Fans

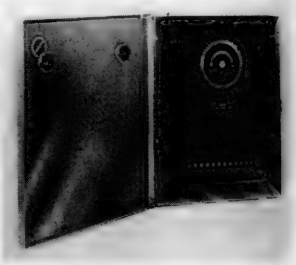
Availability of a new and improved wall or window mounted sheet metal exhaust unit is announced by M & E Mfg. Co., Indianapolis, Ind. The unit is designed primarily for installation in areas where it is necessary to exhaust hazardous fumes, such as paint overspray and engine block cleaning equipment.

The sheet metal window mounted unit is installed in an existing window or concrete block wall. The motor is accessible for inspection and maintenance from inside the room by a convenient access door and is protected from weather by a protective sheet metal cover on the exterior of the building. Incorporating the window unit with a heavy duty belt-driven exhaust fan assures the user of meeting the standards of Underwriters for hazardous locations.

More information? Circle Item 40 on postcard, page 129

Indoor-Outdoor Heat Control

A new unit representing the latest development in automatic heating control of buildings is announced by Tork Clock Co., Inc., Mount Vernon, N. Y. Called Tork Weather Control, it is a combination of an inside control panel and an outside weather head, and automatically regulates the heating of any building. The indoor-outdoor control combination is an efficient method of providing heat in multiple family dwellings, office buildings, factories, hospitals, schools, in any building using automatic gas, oil, or coal heating.



The control automatically performs what would normally require trained capable attendants on constant 24-hour duty, watching and recording outside weather, inside temperature, sun effect, wind velocity, hot-water supply, chimney draft, all at the one time. The new unit's mechanical and automatic performance of all these duties and more, serves to not only effect a savings in fuel costs, with a minimum of boiler room attention, but also provides uniform, comfortable building temperatures.

Heat is cycled on the inside control panel according to outdoor temperature and indoor building satisfaction; the weather control starts and stops the heating plant at pre-selected intervals as programmed on the 24-hour dial. Setting of the cycle tabs and limit control assures rapid morning pickup and heat throughout the system until night shutdown. Once set, the controls need no further adjustment. Panel signal lights constantly indicate proper and current operation to attendants.

More information? Circle Item 41 on postcard, page 129

(*Continued on page* 130)

Half the weight . . .
Half the size of the
average of 7 other leading gas units

Compare weight **. . . Modine 105,000 Btu unit, 95 lbs. Average of 7 other makes, 205 lbs.**

Compare size **. . . Modine 105,000 Btu unit, 8258 cu. in. Average of 7 other makes, 15,184 cu. in.**

BEFORE you buy any gas-fired unit heater, be sure you see Modine's great stainless steel unit. The tremendous space and weight savings achieved make installation easier, less expensive. On one job, it cost the heating contractor $600 less to install 66 Modines than conventional units — savings he passed on to the owner.

What's more, Modine design promotes maximum combustion efficiency, faster heating response. In fact, Modine delivers heat within *5 seconds* after thermostat calls for it.

When you buy Modine, you get the greatest name in unit heating. For 25 years Modine has set the pace in steam and hot water unit heaters. Now you can get this famous balanced performance at low overall cost in Modine Gas-Fired Unit Heaters. For all the facts, see the Modine representative listed in your classified phone book or use handy coupon.

Only Modine Gas-Fired Unit Heaters have *stainless steel* heat exchangers *and* burners

Modine UNIT HEATERS

For free copy of Bulletin 653, clip this coupon and mail today

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completely pre-assembled and wired for forced hot water heating systems in smaller homes
No. 7701
Conversion-Boiler
for smaller homes
Make it
FITZGIBBONS
for every
heating job
"400" Series
for oil, gas or coal fired hot water or steam systems in moderate size homes
"80" Series
"R-Z-U" Junior Series
for large residences and commercial buildings

Every building, from the large skyscraper down to the smallest home, can have the advantages of Fitzgibbons steel boiler heat. Every boiler in the Fitzgibbons "Line" is characterized by simple installation, lowest fuel consumption, and long service life. Time-tested engineering design, strong, steel construction, with the ASME Code as a minimum, assure fine, lasting performance.

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"D" Type
for large buildings and commercial installations.

"Scotch" Type
for large buildings and commercial installations.

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- **News of Equipment and Materials**

or a copy of the following

- **New Catalogs**

Circle the item Numbers in which you are interested and print clearly your name and address with title.

NEW CATALOGS

TUBULAR HEAT EXCHANGER—A new four page bulletin No. 110 on its Paracoil Water Sample Cooler No. 75 is issued by Davis Engineering Corp., Elizabeth, N. J. The widespread application of the heat exchanger unit gives timely importance to this new pamphlet. In addition to the design specifications, a set of charts is included to determine cooling water flow rate for various sample temperatures. Additional features include typical piping hookups and detailed instructions on the installation and operation of the cooler. .....Item 101

AUTOMATIC AIR FILTERS—A 12-page illustrated bulletin No. 500 describing Staynew automatic filters designed for large air volume and high efficiency is announced by Dollinger Corp., Rochester, N. Y. Bulletin contains specifications, engineering and performance data covering automatic filters in a wide range of sizes for any desired air capacity. .....Item 102

METAL HOSE, VARIOUS TYPES—A 32-page illustrated catalog No. 130R on all types of Flexon metal hose is issued by Flexonics Corp., Maywood, Ill. It covers the full range of the company's corrugated metal hose, convoluted hose types, stainless steel flexible metal hose, and numerous special purpose assemblies. Featured is new industrial Rex-Flex heavy duty stainless steel hose. .....Item 103

FABRICATION OF VANES—Fabrication of air turning vanes is made less expensive and more efficient by using Duro-Vane-Rail, described in the new Visual Manual issued by Duro-Dyne Corp., Hempstead, N. Y. Manual shows pictorially how quickly, easily and inexpensively the vanes can be constructed and assembled in square or change-of-size elbows by using the rail. .....Item 104

INDUSTRIAL EXHAUSTERS — Ten exhausters are described in a new folder issued by Torit Mfg. Co., St. Paul, Minn. Ranging in capacity from 350 to 4000 cfm, these exhausters remove fumes, odors and gases from industrial operations. The exhausters are made of heavy sheet metal supported on a sheet steel base. Fans are squirrel-cage type, and are not recommended for handling dust laden air. The air intake is on the side and the exhaust may be had in any position.....Item 105

POWER TRANSMISSION—A 4-page brochure has been issued by Lovejoy Flexible Coupling Co., Chicago, Ill., on its power transmission products which include flexible couplings, variable speed pulleys and transmissions, and universal joints. .....Item 106

1 TO 30 HP. MOTORS—The recently announced line of Tri-Clad 55 motors, built in 1 to 30 hp ratings to latest NEMA dimensions, is described in three new four-color picture-story bulletins available from General Electric Co., Schenectady, N. Y. The publications contain complete descriptions of new maintenance, performance, and protective features of the line, and each includes a double-spread cutaway drawing of the motors. .....Item 107

ELECTRONIC HOT WATER CONTROLS—Complete information on its electronic controls for hot water heating systems is available in Bulletin F 6167 issued by Barber-Colman Co., Rockford, Ill. It describes the flexibility of the electronic outdoor reset hot water controls which, by simply turning a knob, the ratio of change in outdoor temperature to change in water temperature can be adjusted. The electronic panels house all adjustments and may be located convenient to operating personnel. Catalog also contains information concerning the use of an optional night depression with morning warm-up feature. .....Item 108

GLASS BLOCK DATA—A new 24-page catalog, P. C. Glass Blocks for Industrial, Commercial, and Public Buildings, Catalog GB-101, is issued by Pittsburgh Corning Corp., Pittsburgh, Pa. The catalog is designed to be a reference manual for architects, engineers and contractor personnel. Information on physical performance; technical data on light transmission, insulation values, installation detail drawings, accessory materials and complete specifications are fully covered in the new piece. .....Item 109

POWER PLANT COMMUNICATION—A 16-page brochure, Form P-831, has been issued by Radio Corporation of America, Camden, N. J., and devoted to its power plant communication system which saves time in communication throughout the plant, cuts wasted man hours, forestalls or minimizes emergencies and accidents, and enables the existing staff to do more work with less effort. .....Item 110

UNIT HEATER RATING—Bulletin 11, Standard Code for Testing and Rating Hot Water Unit Heaters, Second Edition, has been issued by the Industrial Unit Heater Association, Detroit, Mich. This is a complete revision of the first edition and uses present day instrumentation and practices, all of which were verified by Laboratory work. It is issued jointly with the ASHVE. Its purpose is to provide a standard method of testing hot water unit heaters and is necessary in order to assure proper capacity ratings. .....Item 111

WATER GAGE TELEVISION—Bulletin WG-1813 on equipment for televising boiler water level gages is issued by the Yarnall-Waring Co., Philadelphia, Pa. The equipment includes TV camera, illuminator, monitor and all necessary linkage. Auxiliary viewing monitors are also available. .....Item 112

CORROSION RESISTANCE—A new folder, TDC 160, designed to be of assistance to engineers involved in the selection of stainless tubing and pipe for corrosion resistance applications, is issued by Tubular Products Div., The Babcock & Wilcox Co., Beaver Falls, Pa. It contains information on the comparative corrosion resistance of stainless steels to corrosive media. It presents pertinent data on six widely used stainless tubing steels and several hundred corrosive media at various temperatures. .....Item 113

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SPACE HEATER CLEARS FOG IN MILL—Case study 560-63, issued by Dravo Corp., Pittsburgh, Pa., describes how a dangerous foggy atmosphere in a paper mill debarking house was eliminated by installing oil-fired warm air space heaters. Not only was the fog an accident hazard, it made working conditions miserable. Other effects were that the moisture condensed on the machinery causing it to freeze up, and collected on and in electrical equipment to damage the insulation and cause short circuits and burn-outs. .....Item 114

VANAXIAL BLOWERS — Direct-drive vaneaxial blowers, three types of belt-drive vaneaxial blowers and a special portable blower for exhausting fumes from tanks are described in Bulletin A-110 issued by Hartzell Propeller Fan Co., Piqua, Ohio. The 16-page brochure includes dimension drawings and figures and complete air delivery tables for all of these blowers. Two of the belt-drive models, a high-temperature blower and a new design for low volume, high pressure requirements, are new lines not shown in any previous catalog. .....Item 115

UNDERGROUND INSULATION—Advice on the installation of Gilsulate, the insulation for hot underground pipes, is given in a four-page publication of American Gilsonite Co., Salt Lake City, Utah. The publication shows how the insulant is poured around pipes exposed in trenches. After the material is tamped down, the trenches are backfilled and steam passed through the pipes. In contact with the hot pipes, the material forms a triple zone of insulation that provides permanent thermal insulation and corrosion protection. .....Item 116

PACKAGED AIR CONDITIONERS—Form CS-104, 4 pages, has been issued by The Deering Air Conditioning Co., Cincinnati, Ohio, on its packaged air conditioners for home and commercial use. These units are made in two sizes, 2 and 3 hp. Folder includes descriptive and dimensional and capacity data. .....Item 117

HEAT PUMP BULLETIN—Its all-electric heat pump is described in a four-page bulletin available from Westinghouse Electric Corp., Air Conditioning Div., Hyde Park, Boston, Mass. The heat pump is the completely self-contained system that without water or flame provides warm filtered air in the winter and cool, dehumidified air in the summer. A complete explanation of the heating and cooling cycles of the unit is presented in the bulletin including schematic flow diagrams of the refrigerant and air. Use of existing ductwork is discussed as well as locations in the home of either the three or five horsepower unit. .....Item 118

INDUSTRIAL ELECTRIC HEATING — Principal industrial electric heating applications and methods are described in a new 32-page booklet, 101 Ways to Apply Electric Heat, by Edwin L. Wiegand Co., Pittsburgh, Pa. Illustrated case histories show experience-tested ways to apply metal-sheathed electric heating units in myriad industrial jobs. Physical aspects of installation are shown along with a description of the problem, solution and advantages obtained. Some of the heating jobs illustrated could not be done with any fuel except electricity. .....Item 119

CHART ON POWER SAVINGS—A simplified Power Evaluation Chart is offered by the Chicago Blower Corp., Franklin Park, Ill. It shows how expensive improper fan selection can be in annual operating cost. It also provides a quick, ready-reference way to estimate dollars-and-cents savings on the company's new Airfoil fans. Figures are given both for full 24-hour plant operation, 365 days a year, and for the conventional 8-hour day on a 300-day basis. .....Item 120

PLASTIC PIPE—Plastic Pipe is the title of a 12-page booklet, Form Adv. 603, issued by Republic Steel Corp., Cleveland, Ohio. It tells why the company entered the plastic pipe field, describes the two principal types of plastic pipe made, shows how to join plastic pipe, and lists various engineering data. .....Item 121

PRECIPITATOR FOR GAS CLEANING—A 4-page bulletin with conveniently arranged information for a quick understanding of the special design features of the Cottrell electrostatic precipitator for open-hearth steel making applications, titled Open Hearth Stack Gas Cleaning, is issued by Research Corp, Bound Brook, N. J. The electrostatic method which offers high dust collection efficiencies in cleaning open hearth stack gases at normal operating and maintenance costs is explained in the bulletin. Diagram and cutaway view of the equipment show operating and construction details. ...Item 122

WATER TREATMENT—A folder describing Klarite, a material for treating cooling water, is issued by Water Control Engineering Co., Kansas City, Mo., intended for evaporative condensers, cooling towers, engines and compressors. Product removes oil of fabrication and neutralizes mill scale of the oils used in fabrication, and reduces head pressure in the refrigeration system and cuts down on maintenance. Also available is Klarite B for protecting steam and hot water heating boilers from scale. .....Item 123

CONDENSED INSTRUMENT CATALOG—A new condensed bulletin, entitled Specialized Instruments and Gages, is published by F. W. Dwyer Mfg. Co., Chicago, Ill., presenting the company's broad line of specialized instruments and gages. Included are instruments for accurate measurement of combustion, draft, pressure, flow, vacuum, CO_2, smoke, velocity, static pressure, pressure differential and temperature. .....Item 124

THOUSANDS OF SPRAY NOZZLES—Catalog 24, a comprehensive industrial spray nozzle catalog of 48 pages is issued by Spraying Systems Co., Bellwood, Ill. Thousands of standard and special industrial spray nozzles are illustrated and described. For each nozzle, complete data is listed covering capacity and spray angle. .....Item 125

DUCT INSULATION — Bulletin 567, 8 pages, has been issued by Grant Wilson Inc., Chicago, Ill., devoted to the company's asbestos protected Dux-Sulation flexible insulating blanket for ducts which comes with adhesive tape and instructions for application. Folder includes features, advantages, and methods of application. .....Item 126

GAS-OIL BURNERS—Bulletin B-300 has been issued by Eclipse Fuel Engineering Co., Rockford, Ill., on its fan type combination burners for gas and light oil or gas. .....Item 127

METAL EXPANSION BELLOWS—A 6-page Bulletin 300, issued by Titeflex, Inc., Newark, N. J., describes its special line of metal expansion bellows for conveying gas and liquids available in 87 sizes. Text and diagrams explain the welded diaphragm construction of the bellows and point out how this results in a bellows especially able to withstand high temperature and vibration as well as corrosion. .....Item 128

FINNED TUBE MATERIAL—Engineered fin radiation material made by Pilgrim Industries, Inc., Brookline, Mass., is described in a 4-page folder issued by that company. This product is a fin radiation which comes in flat form and is wrapped around a pipe to make an extended surface unit out of the pipe. Product comes in handy boxes and cartons. .....Item 129

COPPER TUBE—Catalog BC-1 on its types K, L and M copper water tube is issued by Triangle Conduit & Cable Co., Inc., New Brunswick, N. J. Catalog, 14 pages, gives dimensional and application data as well as design information on plumbing and piping systems. .....Item 130

ANTI-CORROSION VALVES—Two catalogs on its Aveco corrosion resisting valves have been issued by Associated Valve & Engineering Co., Chicago, Ill. The one titled Section A, 12 pages, covers needle valves, while Section E, 16 pages, is devoted to safety and relief valves. Construction details, dimensions and capacity tables are included. .....Item 131

FUME WASHER—Bulletin FW-1, published by The U. S. Stoneware Co., Akron, O., describes and illustrates Cyclonaire, a portable fume washer for low-cost fume removal in plants and laboratories. Complete technical data, drawings, performance charts, and dimensional information are included. .....Item 132

PLEASE SEND US MORE INFORMATION. Circle below numbers on which you wish further information.

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22	23	24	25	26	27	28	29	30	
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102	103	104	105	106	107	108	109	110	
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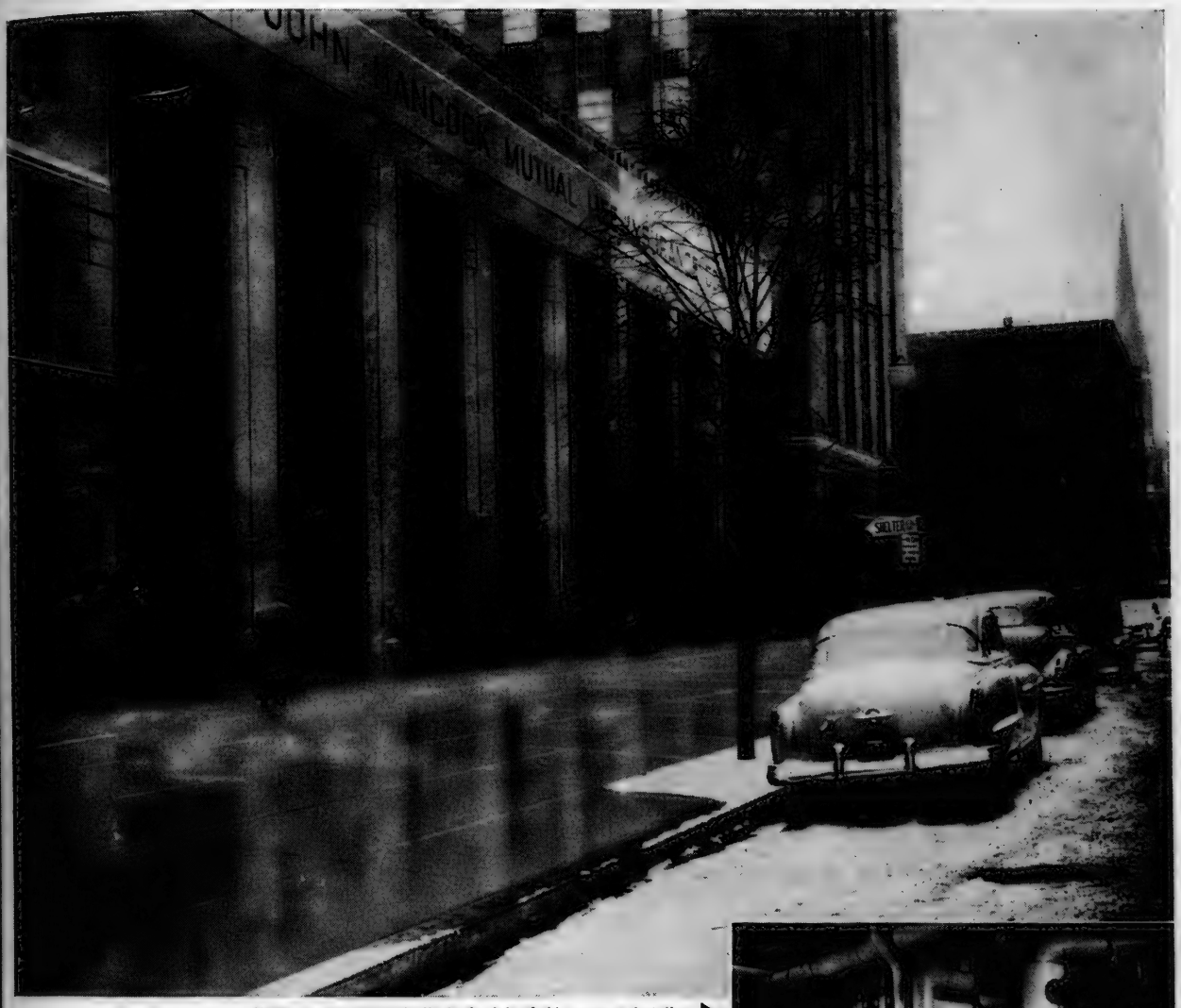
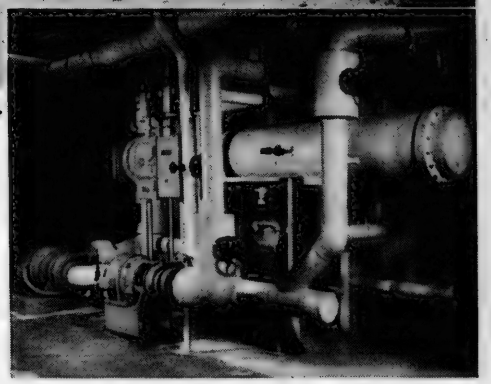
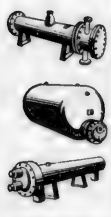


Melting snow automatically is the job of this compact installation, placed in a basement corner of the John Hancock building.



p-k insures John Hancock against snow underfoot



Slippery, icy, snow-covered sidewalks are a thing of the past at John Hancock Mutual Life Insurance Company in Boston. Tubing permanently embedded in the sidewalk carries ethelyene glycol solution, heated by a p-k snow melting converter. Snow is melted as it falls and drains away.

The p-k snow melting converter at John Hancock has capacity to heat 225 gpm of 50% ethelyene glycol solution from 160°F to 180°F with steam at 40 psig., using 976 feet of 3/4 in. 18 gauge copper tubing. The system was designed and installed by Buerkel and Company, Inc., Boston contracting engineers.

Like the John Hancock Company, you will find sidewalk heating a means of promoting goodwill and increasing foot traffic. At the same time you get *insurance* against damage suits resulting from slippery sidewalks, plus definite snow removal time and labor savings. Write p-k now for information on snow melting equipment or any heat exchange problem.

the Patterson-Kelley Co., inc.

920 Burson St., East Stroudsburg, Penn.

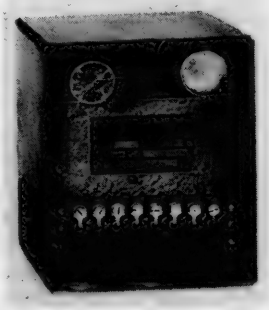
1971

101 Park Avenue, New York 17 • Railway Exchange Building, Chicago 4 • 1700 Walnut Street, Philadelphia 3 • 96-A Huntington Avenue, Boston 16 • and other principal cities

(*Continued from page* 126)

Liquid Level Controls

Two new floatless liquid level controls with sensitivity, accuracy and performance unaffected by temperature, pressure, acids or salts, providing positive hair-line control for liquids of low and high conductivity, at any distance, are introduced by Ferrara, Inc., Oak Park, Mich.



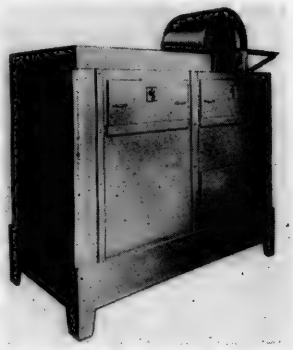
The LM, magnetic type, utilizes a positive action, heavy duty d.c. operated relay for the load circuit with no chatter, no hum or false starts. Electrolysis is eliminated since a few milliamperes of a.c. current through the liquid pilots the device. This type is applicable to the level control of many common solutions, such as water.

The LE, electronic type (illustrated), is a highly sensitive but rugged device especially suited for low conductivity liquids such as refrigerants, alcohol and distilled water. Positive action is obtained with probe circuit resistance as high as 200 meghoms since a unique circuit provides amplification of better than 5 million with a standard cold cathode tube and current of less than 2 microamperes through the liquid. Both units can be used as high or low level cut-off, alarm or differential control.

More information? Circle Item 42 on postcard, page 129

Evaporative Condenser

Evaporative condensers of the blow-through type are available in an improved and expanded variety of arrangements known as Series PF (Perma-Fan), Type C, from Drayer-Hanson, Inc., Los Angeles, Calif.



The product represents advances in housing construction, eliminators, headering, pumps, sump pan drainage and finish. It is manufactured with 14-gage galvanized steel housing, assembled by water-tight construction process which eliminates leakage at joints.

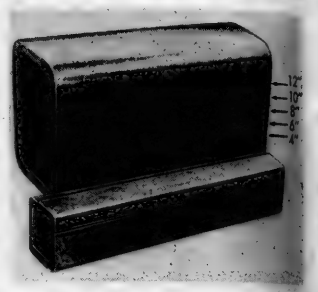
Eliminators, which are hot dip galvanized after fabrication, may be serviced without disturbing duct connections. Units are equipped with separate direct-connected motor driven pumps, mounted to unit with inter-connecting water piping. Pumps with bronze impellers, circulate ample water, assuring a fully flooded coil.

Corrosion-resistant sump pan is included on legs to provide ventilation, with sufficient room to make drain connection. The unit as reengineered, with protective fan guard and in capacities ranging from 5 to 65 tons, is a versatile unit for either outdoor or indoor installation. For ease of handling, it also has the advantage of complete field disassembly.

More information? Circle Item 43 on postcard, page 129

Pipe for Corrosive Sewage

Chemi-Drain, a new kind of channel pipe designed by Dow Chemical Company and manufactured by The Logan Clay Products Co., Logan, Ohio, is available for sloping drains and gutters in chemical plants and other corrosive service.



The new channel pipe is made of vitrified clay for permanent protection against corrosion by acids and other chemicals. It is manufactured in double sections with five grooves or kerfs in each side so that the installer can divide the double sections into single sections of any desired depth from four to 12 inches. Curb tile is used to cover the upper edges of the channel pipe, making the entire installation perfectly flush with the floor. The channel can be covered with a grille or solid floor plate.

More information? Circle Item 44 on postcard, page 129

Announces Price Reductions

Price reductions ranging up to 24% on its full line of air conditioning equipment are announced by Bryant Heater Div., Affiliated Gas Equipment, Inc., Cleveland, Ohio.

More information? Circle Item 45 on postcard, page 129

Simplifies Vane Installing

A new, improved All-Tite vane runner, said to provide the quickest and cheapest method for installing vanes in square elbows of air conditioning and forced draft heating ducts, is announced by Elgen Mfg. Corp., Long Island City, N. Y.

The vane runner, with slotted knobs, is made of 24-gage galvanized steel and will accommodate either single or double blades. Among its advantages are elimination of punching, notching, riveting, spot-welding and layout, and it requires no special chisels or tools.

Vanes are locked in a few seconds with shears or hammer, and the assembled unit is quickly fitted in elbow, fastened with screws, and is thoroughly rigid and rattle-proof. The runner is delivered in 8-foot lengths, 20 strips per bundle. It is said to cut the cost of installing vanes by as much as half.

More information? Circle Item 46 on postcard, page 129

(*Continued on page* 132)

B.A.C.

evaporative CONDENSERS up to — T. R.

cooling TOWERS up to — T. R.

There's a B.A.C. factory-assembled
Evaporative Condenser or Cooling Tower
in a size that will fit your job exactly!

BALTIMORE AIRCOIL COMPANY, INC. • 2615 Mathews St., Baltimore 18, Md.

(*Continued from page* 130)

Commercial Water Heater

A new commercial water heater, the Model B-65, is announced by The Permaglas Div., A. O. Smith Corp., Kankakee, Ill.

This new 65-gallon glass-lined unit is designed to generate 130 degree water for commercial purposes and at the same time, through an adjustable thermostatic mixing valve, will furnish general purpose hot wtaer. In the case of users such as small restaurants, for example, this device eliminates the need for two water heaters. The heater also may be applied to general purpose hot water requirements for many other commercial establishments as well as large homes.

For the first time glass-lining is employed in the company's commercial line of water heaters.

More information? Circle Item 47 on postcard, page 129

Portable Dust Bin for Cyclone

A portable dust bin as optional equipment for its Model 219 twin cyclone dust separator is announced by Torit Mfg. Co., St. Paul, Minn. It is intended for use where large volumes of dust require frequent emptying of the dust reservoir for disposal or salvage.

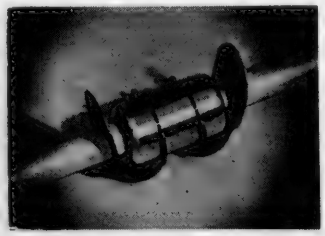
Use of this portable dust bin requires that the Model 219 unit be mounted on legs and equipped with a hopper bottom. From this hopper a 12-inch diameter air-tight flexible sleeve leads to a lid that fits onto the bin with quick acting clamps.

According to the maker this bin materially reduces the down time required to change dust bins. All that is necessary is to loosen the four clamps, raise the lid lever and roll out the bin. Because of its capacity—eight cubic feet—the bin is mounted on rubber-tired casters. Where disposal or salvage points are located some distance from the dust separator it is advisable to order two or more of these bins.

More information? Circle Item 48 on postcard, page 129

Quick, Simple Pipe Coupling

A new coupling, the Meca, designed especially to ease and simplify the process of connecting tubing or pipe in any size range and for any purpose, is announced by The Master Enterprise Corp. of America, Tulsa, Okla. The coupling is the essence of simplicity, requiring no threading, flares, ferrels, or tools of any kind to make the connection. In a matter of seconds the most inexperienced can connect the tubing or pipe into a sealed connection able to withstand extremely high pressures. To apply, press the spring clip, insert the tube, and release the spring. No wrenches are required.



One of the principles of the coupling is the grooving of the interior of the coupling. At each end are grooves containing O-rings of rubber, silicone, or tefalon, depending upon use. The sleeve is tapered on the inside to allow for any variation in the outside diameter of the tubing or pipe. The coupling has a stop in the center that allows the insertion of the tubing or pipe to fit equally in each side. The spring clip grips tighter as pull pressure is applied.

The coupling is available in all sizes to fit the needs of all industries and applications.

More information? Circle Item 49 on postcard, page 129

Heavy Duty Oil Burner

A heavy-duty pressure atomizing commercial oil burner is announced by Iron Fireman Mfg. Co., Cleveland, Ohio. This new burner, known as Model C-1-A, for firing No. 2 or lighter fuel, is available in capacities ranging from 4 to 8 gph.

The burner is built around a rugged cast iron fan housing with convenient external adjustments provided for the atomizing nozzle position and position of the air diffuser assembly. This permits adjustments to be made while the burner is in actual operation, facilitating setting of the burner for maximum combustion efficiency and allowing the most suitable flame shape for the combustion chamber.

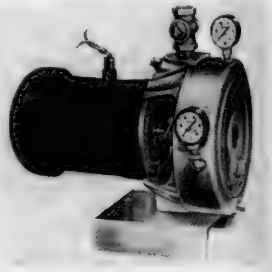
The burner is equipped with a totally enclosed, permanently lubricated, ball bearing motor.

Burners are available for use either with stack switch or electronic controls in draft tube lengths of 9, 16, or 22 inches, and feature twin nozzles for improved atomization.

More information? Circle Item 50 on postcard, page 129

New Centrifugal Pump

A Burks pump known as the IHV Series in introduced by Decatur Pump Co., Decatur, Ill. Designed primarily for booster, circulating and air conditioning applications, this centrifugal unit will find many domestic and industrial uses. Each unit is equipped with supply and discharge pressure gauges, and control valve for adjusting to the most efficient pressure for each installation.



A feature of the unit is the design which permits it to be used either in a horizontal or vertical position, without any mechanical changes, depending on the type of installation desired.

All sizes, available through 1½ hp, have heavy duty, long-life motors. Specifications list capacities to 50 gpm and total heads to 125 feet.

More information? Circle Item 51 on postcard, page 129

(*Concluded on page* 134)

"AUTOMATIC CONTROLS CUT OUR COAL BILL 20%!

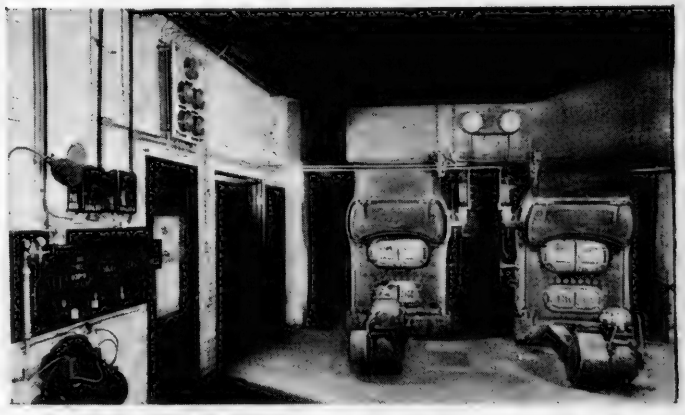
"We gave our modern coal-heating installation an additional boost in efficiency with automatic controls . . . saved $600 the first season,"

says R. C. Smith, Manager
Northern Finance Company, Northern Building
Green Bay, Wisconsin

Located in the heart of the city, Northern Finance Company's coal-heated building meets strict smoke control regulations. Burned properly, coal is clean and convenient.

"Up-to-date coal equipment has long supplied our building with dependable, *economical* heat. But a small additional investment in new automatic draft and building zone controls brought us even bigger savings. We cut fuel costs $550 to $600 a year."

Additional case histories, showing how other types of plants have saved money by burning bituminous coal with modern equipment, are available upon request.



The stoker-fed boilers and newly installed control panel used in heating this modern office building. Approximately 285 tons of coal are used annually.

How modern coal equipment can save you dollars

If your plant is more than a few years old, you can probably boost its efficiency and save money with modern combustion equipment. For example, a small investment in automatic combustion controls, or an efficient forced draft system, may bring you big savings in both fuel and labor.

And if your plant is over 10 years old, chances are you can make an even bigger saving. You can save up to 40% on fuel alone by installing modern combustion equipment. You can reduce labor costs substantially with modern coal- and ash-handling equipment.

Call in a consulting engineer. He can give you advice on just what equipment can best fill your specific needs . . . and return you big savings year after year with coal.

BITUMINOUS COAL INSTITUTE

A Department of National Coal Association
Southern Building, Washington 5, D. C.

If you operate a steam plant, you can't afford to ignore these facts!

BITUMINOUS COAL in most places is today's lowest-cost fuel, and coal reserves in America are adequate for hundreds of years to come.

COAL production in the U.S.A. is highly mechanized and by far the most efficient in the world.

COAL prices will therefore remain the most stable of all fuels.

COAL is the safest fuel to store and use.

COAL is the fuel that industry counts on more and more—for with modern combustion and handling equipment, the inherent advantages of well-prepared coal net even bigger savings.

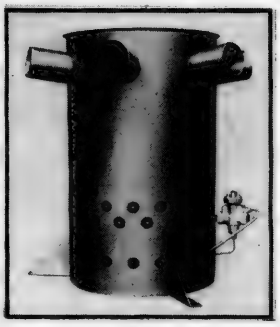
FOR HIGH EFFICIENCY ★ FOR LOW COST

YOU CAN COUNT ON COAL!

(*Continued from page* 132)

Portable Space Heater

National distribution for the new Heatorama portable space heater, fueled by liquid petroleum or natural gas, will be handled by Weldit, Inc., Detroit, Mich.



The heater is unique in that it has six 3-inch open end pipes for directional heat flow. It is most versatile, as it can be used singly or in batteries for large areas. It generates 50,000 Btu per hour at 6½ ounce pressure.

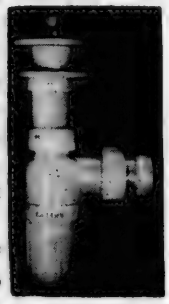
It is portable, weighing 30 lb, and capable of heating large areas. It can be stood on the floor or suspended with wires. It is safe, being equipped with Honeywell C-585 pilotstat with 100% safety shut-off. It is exceptionally clean as it uses petroleum liquid or natural gas.

The heater is ideal for the protection of plaster, cement, concrete construction during cold weather and will increase the comfort and efficiency of workmen on the job. It does an excellent job of drying out basements, freight cars and truck trailers, and also can be used with great success for temporary space heating, large area warehouses, auction barns and tobacco-curing sheds.

More information? Circle Item 52 on postcard, page 129

Laboratory Sink Unit

Proclaimed to be an important contribution to sink sanitation, increased efficiency, durability, and greater utility, an all-polyethylene sink unit is announced by Arthur S. LaPine and Co., Chicago, Ill. It is dent-proof, break-proof, chemical and acid-resistant, and may be installed easily on any laboratory sink.



Called the Lanco sink unit, this equipment consists of stopper, high level drain, strainer, lock-nut, plug, trap, and outlet union.

The trap may be unscrewed without the aid of tools; in fact, anyone can remove, empty, rinse and replace it in seconds. A few turns of the trap produce a watertight joint without the need for washers.

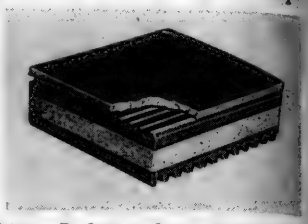
Polyethylene is resistant to mineral acids, alkalies, hydrofluoric acid, and fluorine compounds.

The unit is compact and easy to clean. It is unaffected by corrosive materials and mercury. Moreover, it is germ and infection-proof, frost-proof and its surface is non-adherent.

More information? Circle Item 53 on postcard, page 129

Simple Vibration Damper

The VPS Elasto-Rib damper, an effective, inexpensive vibration isolating material, can help manufacturers increase machine and worker productivity by allowing quick re-arrangement of production lines for new setups without the usual down-time, is announced by the Korfund Co., Long Island City, N. Y. This pad-type damper adds mobility to heavy equipment by eliminating expensive bolting to floors, yet prevents machine walking. It has a long useful life, does not pack down, and can be used over and over in new locations. Typical applications include machine tools, air conditioning equipment, and engines.



The rib utilizes the elastic and damping properties of both cork and rubber, combined to handle like a single material, providing better performance than either alone because vibration and noise are impeded at boundaries between materials of different densities. It has a core of cork plate permanently bonded between two layers of Neoprene rubber deeply grooved to increase deflection of the cushion over a wide range of loadings, and to form a non-skid surface which resists shifting of the machine.

More information? Circle Item 54 on postcard, page 129

Styrene Rubber Sheets

Ampcolite, a styrene rubber blend sheet in widths up to 48 inches and thickness up to 1 inch, and which supplements the company's standard line of Ampcolite pipe and fittings in IPS sizes up to 2 inches, is announced by Atlas Mineral Products Co., Merztown, Pa.

More information? Circle Item 55 on postcard, page 129

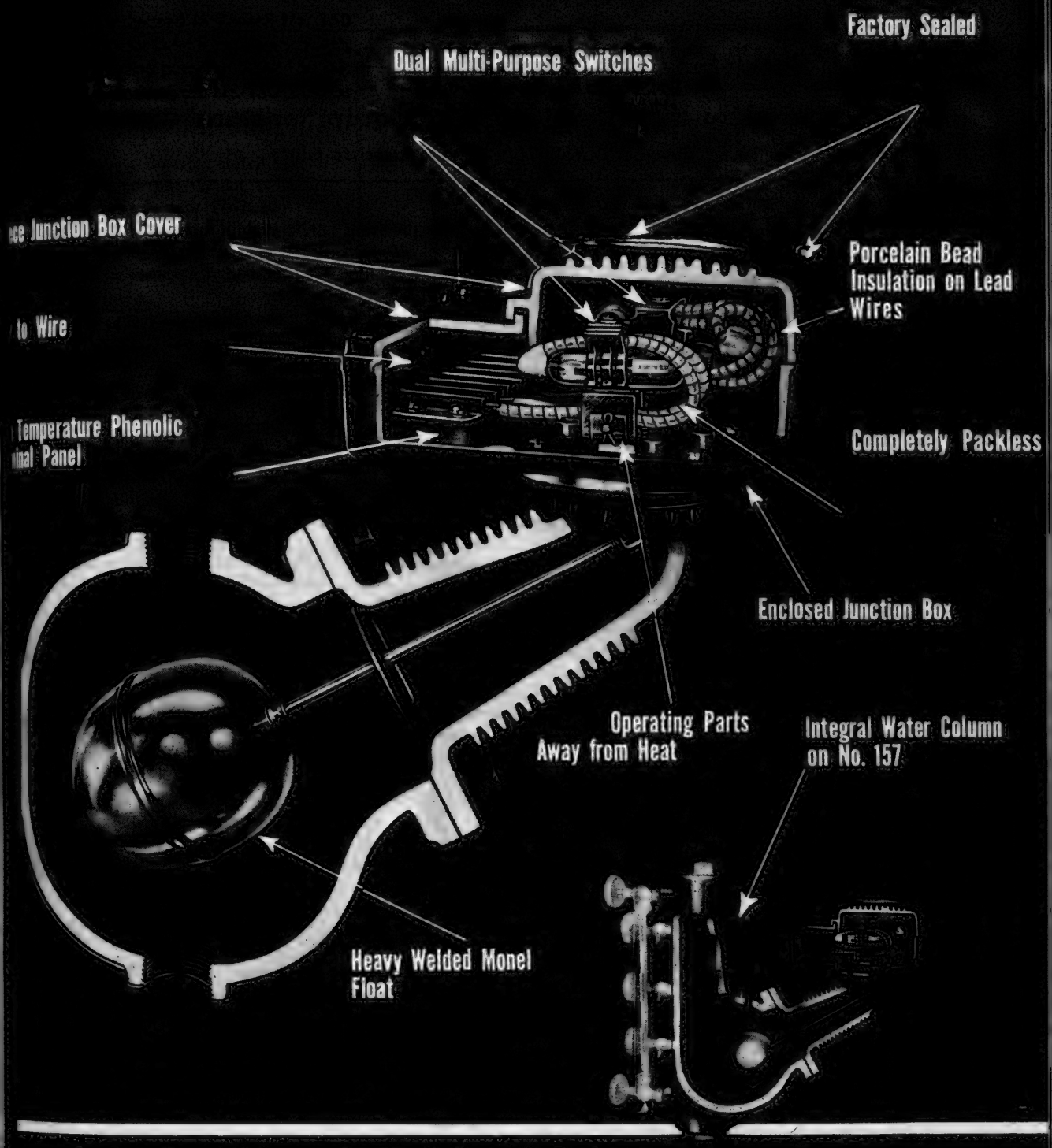
A.C. Motor Line Revised

A line of well protected, versatile squirrel-cage induction motors is announced by Reliance Electric and Engineering Co., Cleveland, Ohio. The line, including protected and enclosed motors for all industrial purposes, is being built to recently adopted NEMA standards.

Research in the fields of new insulating materials, ventilation, heat transfer and more efficient electrical designs has made possible greater horsepower in more compact space with equal and in some cases even greater liberality than in past designs. Research has also led to better protection of the motor windings, leads and bearings.

The first of the new Reliance motors to appear will be built for 1, 1½ and 2 hp applications, in frame sizes 182 and 184. The balance of the line, up to and including 30 hp, will be introduced at regular intervals during 1954 and the early part of 1955. The present Reliance a-c. line will continue to be available during this change-over period to fill the needs of those users who wish to complete current projects with motors as they are now being built.

More information? Circle Item 56 on postcard, page 129



These are the McDonnell-developed features that make the No. 150 the standard of value. No other pump control and low water cut-off offers so much field experience and time-proved dependability.

PRODUCT APPLICATIONS

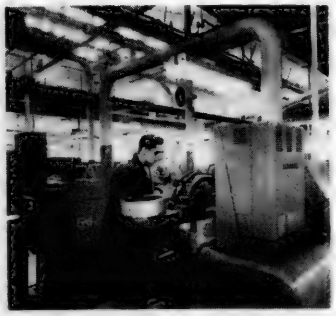
New, Unusual, or Ingenious Uses of Equipment and Materials

Conducted by WM. B. FOXHALL, Associate Editor

Oil Mist Stopped by Precipitator

PROBLEM: At the Holo-Krome Screw Co., Hartford, Conn., air-borne oil mist from thread grinders was creating a safety hazard and maintenance problem. Tools, gages and floors became slippery with oil while windows, light fixtures and nearby electrical machinery were coated with an oil film.

SOLUTION: Two Westinghouse PO-12 oil mist control units were ducted to the offending machines. Now oil mist from cutting and grinding operations is drawn through the Precipitron units and electronically removed. Cleaned air is returned to the room; collected coolant oil is piped back to the thread grinders for re-use.

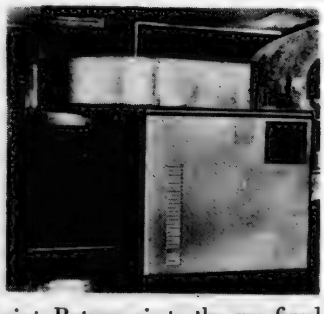


RESULTS: Safety and fire hazards from slippery floors and oil-coated electrical machinery have been eliminated. Maintenance work involved in cleaning windows, walls and fluorescent lighting has been substantially reduced and savings from reclaimed coolant oil have proved considerable. In winter, heating fuel costs are effected since the Precipitron units return cleaned air to the room rather than exhausting it to the outside.

Old Home Air Conditioned

PROBLEM: Occupants of a 40-year-old frame residence in Nutley, N. J., wanted to provide air conditioning for 8 spacious rooms, including 4 upstairs bedrooms and a basement recreation area. The original house design included steam heat with no provision for forced air supply or return ducts to individual rooms.

SOLUTION: Nutley Chrysler Airtemp dealers recommended a complete modernization program including substitution of warm air for winter heating in place of the steam system. Air supply ducts to each room were furred-in. Ducts to second floor outlets were built into corners of first floor rooms, then covered with plaster and paint. Return air to the gas fired Airtemp furnace is brought through a large grille in the living room floor. A secondary supply of outside air is drawn through a duct located in the foundation wall under the front porch. A fully automatic Airtemp 3-hp water cooled residential air conditioner was installed for summer cooling. Total cost of the project was less than $2,000.



RESULTS: According to owner Lee Richardson, the new system provides added comfort, cleanliness, and a healthier atmosphere, in addition to adding appreciably more than its cost to the value of his house.

Airlines Terminal Uses Perimeter Air Conditioning

PROBLEM: Design for the heating and cooling system for New York's east side airlines terminal, which has been constructed at a cost of $7 million, called for a system serving outside zones more or less along conventional lines but with all possible attention to reducing costs.

SOLUTION: The system selected is called Unibay, a development of Eugene J. Brandt & Co., Inc., consisting of the basic, under-window, convector-blower system but redesigned so that only one fan-coil air conditioning unit is placed in an extended enclosure capable of serving three or more windows. Hence each unit services an area or bay now requiring three conventional units. The Unibay system, one of four basic cooling, heating and ventilation systems used in the new building, is installed along the four walls of the concourse, an upper level area devoted chiefly to office space. Each enclosure is approximately 26 feet long and serves three windows. A single fan-coil unit feeds warm or cool air through a duct to three sets of adjustable grilles located under each window. Cooling and heating is accomplished by chilled or hot water flowing through the fan-coil unit. Each well is controlled as a separate zone to handle varying loads. A 300 ton Worthington centrifugal compressor supplies refrigeration for the chilled water serving the cooling systems used in the entire building. District steam is used for heating and hot water requirements. At full capacity, about 15,000 pounds per hour will be used. Other sections of the building will be air conditioned through separate systems using the same central supply of chilled water. Over a mile of duct work will be used in separate systems serving ventilation requirements of various sections of the building.

RESULTS: The Brandt company, a firm of mechanical contractors, which installed all heating and ventilating systems in the terminal, estimates that the Unibay can effect 25 to 30% savings over other types of fan-coil enclosures.

COMPACT COOLING TOWERS OF GROWING IMPORTANCE IN RESIDENTIAL COOLING

Market surveys reveal that the sale of room air conditioners for homes has increased by 600% since 1947. In 1952, total sales of both cabinet and window types for homes was 251,000 units. Substantial gains were registered in 1952

and the 1953 figures are expected to surpass 500,000 units. It is expected that the trend will swing to built-in central cooling system. Residential air conditioning, which originally "caught on" in volume in the Southwest is rapidly moving North and East in popularity...and promises to be an even bigger market in 1954.

To meet the need for adequate cooling towers for "built-in" residential air conditioning installations, the Binks Manufacturing Co. has introduced an *extra quiet* unit which can be located in the basement, garage or yard. This compact cooling tower is Model B-23-B. It is designed specifically for home use, is furnished complete with a small cir-

culating pump. It is blower driven by a single motor. This is suitable for loads from two to three tons commonly offered to the consumer market.

Full information on this specially-designed, moderately-priced unit may be obtained by writing direct to the manufacturer, Binks Manufacturing Company, 3120-38 Carroll Ave., Chicago, Ill. Ask for Bulletin 47-C. The new unit is now in production. ADV.

Achieve maximum cooling WITHOUT NOISE!

Binks
SERIES 3-B
Cooling Tower

- Only dry air passes through the air propulsion assembly. This reduces corrosion and maintenance.
- Non-clogging ROTOJET nozzles produce maximum cooling. The whirl chamber causes fine fluid break-up.
- Air current moves up in opposite direction to downward water flow, thereby accelerating the cooling rate and volume.

For use indoors or out, a Binks *blower-type* cooling tower provides the cooling efficiency you want—*plus* easy, *low-cost maintenance*... and smooth, *silent*, dependable operation. A Binks type 3-B tower is *extra quiet* because its squirrel-cage blowers provide ample air movement while running at slow speeds.

Binks spray-deck construction steps up cooling efficiency by "filming" the water to expose more surface to the cooling air. This assures maximum heat transfer. *Controlled* air movement through the tower makes it independent of natural breeze.

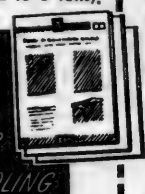
You pay no more for this extra performance when compared with other equipment of similar size.

A COMPLETE LINE OF NATURAL DRAFT AND MECHANICAL DRAFT COOLING TOWERS AND INDUSTRIAL SPRAY NOZZLES

REPRESENTATIVES IN ALL PRINCIPAL CITIES • SEE YOUR CLASSIFIED DIRECTORY

SEND TODAY for these bulletins:
No. 47-A—Type 2-B (3 to 30 tons);
No. 47-B—Type 3-B (1 to 108 tons);
No. 47-C—Type B-23-B (2 to 3 tons).

Binks
EVERYTHING FOR WATER COOLING



MAIL COUPON TODAY!

Binks Manufacturing Company,
3120-38 Carroll Ave., Chicago 12, Ill.
Gentlemen: Please rush FREE Cooling Tower Bulletins as checked:

☐ Bulletin 47-A ☐ Bulletin 47-B ☐ Bulletin 47-C

NAME_____
COMPANY_____
ADDRESS_____
CITY_____ ZONE_____ STATE_____

Detroit Store Hides Ducts with Ceiling of Light

PROBLEM: Plans for redecorating the women's apparel floor at Kline's department store in Detroit called for a new illuminating system which would hide both the sprinkler system and duct work for air conditioning.

SOLUTION: A new ceiling called the Acusti-Luminus ceiling, development of Luminous Ceilings, Inc., was installed. The ceiling consists of panels or corrugated translucent plastic behind which fluorescent lighting is installed. Light is diffused through the plastic and illuminates the area without contrasting shadows or color distortion. Intensity of illumination is varied by spacing of the lamps above the plastic diffuser. The air conditioning duct system is concealed above the plastic ceiling and conditioned air is discharged into the space occupied by the lamps. Air diffuses throughout the selling area through the spaces along channels supporting the corrugated plastic. The plastic ceiling also covers the entire springler system, and can be so installed because the plastic material softens and falls away at 145F leaving an unobstructed area for sprinkler operation when a fire occurs.

RESULTS: Even, draft-free distribution of air is accomplished through openings along the supporting channels. Space between the plastic ceiling and the true ceiling is used in some cases as a plenum and may eliminate duct work in some areas. Even diffused lighting and air conditioning promotes merchandising.

Multiple Boilers Heat School

PROBLEM: In the new Worcester County Senior High School, Worcester County, Md., the heating system was to provide flexibility for intermittent use of the various wings of a single story building constructed for the daily use of 700 students and occasional evening occupancy for special functions.

SOLUTION: Eleven residential type General Electric oil-fired hot water boilers were installed, divided among three separate locations in banks of four, and three, with each bank serving a wing of the school. Simple controls provide individual temperature control for each bank of boilers. When only part of the school is in use for special functions, only the boilers serving that part need to be used. The boilers in each bank cut in automatically as the demand for heat increases. Thus, on a mild day only one boiler in each wing may be in operation.

RESULTS: Individual temperature control for each wing is provided to adjust for sun load, occupancy, or exposure of the wing. No full time stationary engineer is required. A cost analysis shows that a multiple installation of residential boilers costs less to install and operate, is easier to maintain, and costs less to service. No high chimney or induced draft is required with the residential boilers. Possibility of a complete breakdown during the winter is minimized, because boilers can be serviced one at a time.

Electric Heaters Provide Spot Comfort

PROBLEM: At a middle-west steel warehouse, sheet metal workers had been using wood burning salamanders during the winter to keep their hands warm enough for working at sheet metal forming machines. The arrangement was unsatisfactory because of the smoke and fire hazard as well as the time required for attention to wood fires.

SOLUTION: Chromalox electric radiant comfort heaters, product of Edwin L. Wiegand Co., were mounted directly on the sheet metal pressures and shears in such a manner as to focus gentle heat on hands and feet of operators.

RESULTS: Men appreciate the continuous comfort provided on the job. Time previously lost by frequent trips to warm up around salamanders has been eliminated. Operating cost of the electric heating method is less than the cost of coal and scrap wood used in salamanders for the same purpose. Radiant heat is more effective because it is relatively unaffected by air motion.

Steam Trap Blows Alarm Whistle

PROBLEM: A Dallas boiler installation was equipped with a low water cut-off but required some sort of signal to warn the engineer before the cut-off went into operation so that he could start boiler feed pumps.

SOLUTION: A No. 21 Armstrong ball float trap was installed in parallel with the water column of the 180-hp boiler. When the boiler water drops to a predetermined level, the trap blows a whistle installed on its air vent just prior to operation of the low water cut-off.

RESULTS: Upon hearing the whistle, the engineer starts the stand-by boiler feed pump which brings the boiler water level back to its proper position. The trap then stops blowing the whistle.

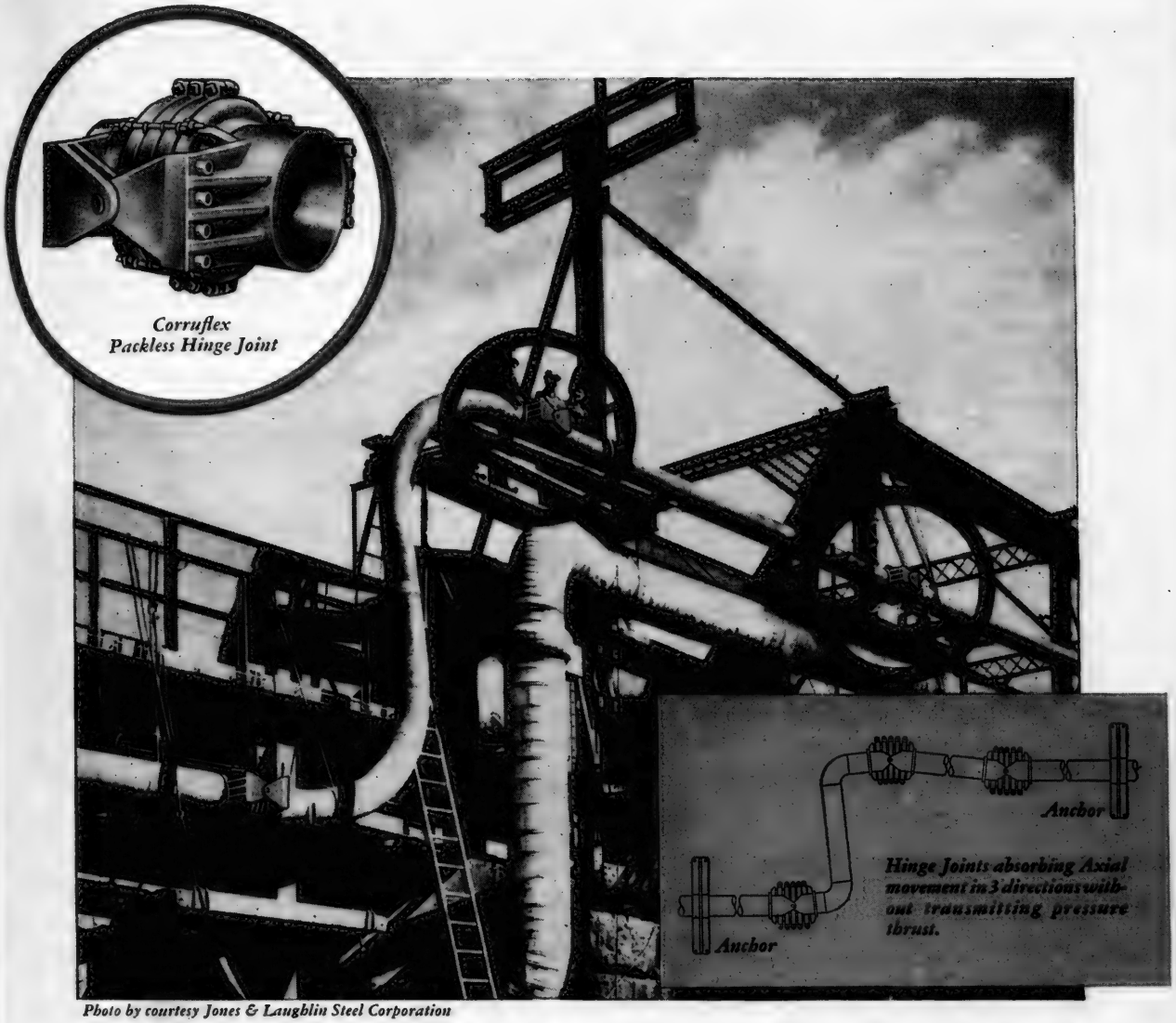


Photo by courtesy Jones & Laughlin Steel Corporation

HINGING A 14" STEAM LINE

● The Jones & Laughlin Steel Corp. in Pittsburgh last year had an excess of steam on one side of the Monongahela River and not enough on the other, where it was vitally needed. To correct this condition, J & L engineers planned to construct a high-pressure, superheated steam line along existing bridges and trestles to transmit the excess of steam to the other side.

However, a great difficulty soon appeared. If conventional expansion joints or loops were used at the 90° turns, pressure thrusts at anchor points would have been great enough to damage the bridges and trestles and actually cause these structures to collapse into the river.

Obviously, something else had to be used. With the aid of Adsco's Engineering Department, J & L "hinged" the pipe line with Corruflex Hinge Joints. These joints cannot develop pressure thrust because their two ends are held apart. They permit movement of a pipe line while keeping anchor loads at a minimum. When used properly, as pictured here, they will permit axial motion of one section of pipe line by permitting angular motion of another section.

Hinge Joints are only one type in the diversified Corruflex line of packless expansion joints. If you have a pipe expansion problem, consult Adsco. Making the world's most complete line of expansion joints, both slip and packless, Adsco will have the right answer.

ADSCO
ENGINEERED
PRODUCTS

AMERICAN DISTRICT STEAM COMPANY, INC.
GENERAL OFFICES
NORTH TONAWANDA, NEW YORK
PLANTS
NORTH TONAWANDA, N. Y., AND RICHMOND, CALIF.

Fiber Pipe Handles Acid

PROBLEM: At the Schroeder Engraving Co., Milwaukee, Wis., a drainage system was required to handle, singly and in combination, nitric acid, muriatic acid, acetic acid, chloride of iron, benzol, alcohol, turpentine, and gasoline suspended in a highly abrasive solution of pumice stone. There was also the problem of venting a zinc etching machine handling nitric acid.

SOLUTION: An experimental acid drainage line of 4-inch L-M Fibre pipe, product of Line Material Co. of Milwaukee, was installed in 1946.

RESULTS: A. W. Schroeder, president of the concern, reports that the original installation of L-M Fibre pipe has been in place for seven years. Each year, during a normal overhaul period, the pipe is disassembled in order to remove pumice settlings which normally accumulate within the line. There has been no appreciable corrosion within the pipe. Success of the drainage line prompted the recent installation of a section of 6-inch fiber pipe for venting the zinc etching machine. After two years of service, the vent pipe has been unaffected by corrosive action of nitric acid fumes.

Church Cooled by Outside Equipment

PROBLEM: Saint Francisco di Paola, a San Antonio church renowned for its architectural beauty, had recently been completely redecorated when the decision was made to air condition the building. The problem of the engineers was to provide satisfactory cooling without detracting from the aesthetic value of the remodeled interior.

SOLUTION: The G. H. Dillard Co., A. H. Thomason, engineer, designed and installed a system placing a U. S. Air Conditioning Corp. 20-ton self-contained central station unit, outside the building. The supply duct was taken through the outside wall and concealed in the wall-like railing of the organ and choir loft above the entrance to the nave. Air is distributed at low velocity through five large grilles placed along the face of the railing. For return air, two stained glass windows adjacent to the outside equipment were removed and replaced with return grilles.

RESULTS: Wide area supply and return grilles assure low velocity distribution of air without disturbance of candles at the altar. Noise level is imperceptible. Interior decorating is practically untouched. Outside equipment has been shielded from view by construction of a matching extension to the front wall of the building. A cooling tower has been located out of sight in the rear of the building. The only visible evidence of the system is the appearance of supply and return grilles, all of which are located to the rear of the congregation. With outside temperatures as high as 105 F, the inside temperature was maintained at 74 F or lower. Monthly utility bills for air conditioning were less than $50.00 for July and August.

Wash Water Tempers Milking Rooms

PROBLEM: The milking parlor and milk-house on the Donald Lape Dairy Farm in Wisconsin were uncomfortably cold for milking and washing of utensils during winter.

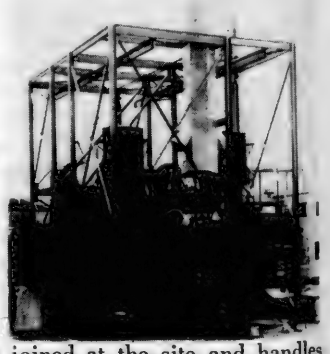
SOLUTION: Each room was equipped with a Modine unit heater designed for use on hot water systems. Both units are piped to a stoker-fired hot water boiler which also supplies water for washing equipment and utensils. Hot water from the service supply circulates through the heaters by gravity flow.

RESULTS: Air in the milking parlor and milk-house is tempered without the necessity of a separate heating system. Working conditions are improved and the chapping and cracking of the skin of workers' hands, normally resulting from immersion in water during freezing weather, is greatly reduced. During periods when heat is not required, water is not circulated and fans are shut off.

Acid Stack Made of Plastic

PROBLEM: A southern chemical plant required a venting stack for an acid concentrator. The stack was to handle hydrofluoric acid fumes.

SOLUTION: Schori Process Division of Ferro-Co. Corp. in Long Island City manufactured a stack of a special Iolyte laminate of fiber glass and cotton reinforced polyester laminate. The stack is 32 feet high and has a diameter of 5 feet. It was made to specifications in three sections and shipped by flatcar. The material was fabricated without molds.



RESULTS: The stack was joined at the site and handles the acid fumes without corrosion. Tensile strength of the material is such that it can be used structurally without breaking or cracking.

You'll see why you get better performance . . .

- Electronically rolled, expanded joints . . . permanently leakproof.
- Tubing held rigidly apart by separators . . . no rubbing, no noise, no wear.
- Baffling engineered for rapid heat transfer . . . maximum operating efficiency.
- Head passes designed for free flow . . . minimum pressure drop.

Taco HEAT EXCHANGERS

. . . engineered to fill *your* requirements

Taco Field Engineers have the experience and technical "know-how" to help you select exactly the right Heat Exchanger for conditions to be met: flow, velocity, temperature rise, log mean temperature difference, pressure drop, transmission rate, and steam pressure or temperatures of other heating media.

For complete information, write for "Taco Heaters" catalog containing Taco's "pin-point" Selection Charts.

Taco

Circulating Pumps

TACO HEATERS, INCORPORATED
137 South Street
Providence 3, R.I.

Tank Heating Units

Condensate Coolers
Converters
Fuel Oil Heaters
Oil Coolers
Radiation Heaters
Water Heaters

Chillers

Need help applying small motors and blowers to your products?

Redmond Call On . . . "Customer Engineering Service"

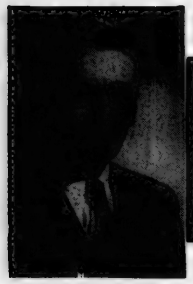
NEXT time you're up against a tough application problem involving low-range power, take advantage of Redmond's "Customer Engineering Service." It's a complete service . . . specialized . . . maintained solely to help you find exactly the motor you need for the job you want done. And important, too, is the fact that Redmond Company, Inc. specializes exclusively in the design, development and manufacture of Micromotors up to 1/6th horsepower, small blowers up to 280 c.f.m. and controllers . . . *no consumer products to compete with the products of customers.*

Redmond COMPANY, Inc.

Main Office: OWOSSO, MICHIGAN

Western Area Office:
1260 So. Boyle Ave., Los Angeles, Calif.

REDMOND



Experience is my Classroom

By T. W. REYNOLDS

• QUICK FIGURES FOR FUR VAULT TONNAGE

Not long since I had occasion to investigate the amount of refrigeration tonnage required for different areas and heights of fur vaults (24 ft x 63 ft and 63 ft x 98 ft, each 13 ft and 18 ft high.) and thereby derived some convenient short cuts from often used detailed methods. Rule of thumb is usually sufficiently accurate with fur storage applications, because any discrepancies are of no great magnitude when the total heat gain itself is so small.

At a rule, the number of garments multiplied by 8, or the cubic feet of space multipled by 2, either product divided by 12,000, will give the tonnage required. This is on the basis of usual enclosing structure of 8-inch concrete, lighting as usual (one watt per square foot), and 4-inch cork insulation (roof, floor and walls), or the equivalent in thermal value. For 6-inch cork, tonnage can be reduced not more than 15% of the total heat gain, because the internal heat gain is a constant regardless of thickness. It is most essential, however, whatever thickness is used, that the insulation be thoroughly waterproofed to eliminate moisture diffusion. No matter how well one designs a vault for greatest space and minimum costs he seldom gets enough garments in that space to satisfy the owner. Storage of garments in three tiers high proves the most economical in first cost and it requires slightly less tonnage. With the exception of heat gain from walls, all of the heat gains remain the same regardless of vault height.

The usual heat load comes from heat leakage through walls, floors, and roof; the heat introduced by ventilation or by air infiltration through joints and surfaces of the space; infiltration when the vault door is opened; and the heat gain from workers, lights and perhaps motors. Insulation, will have but little affect on air infiltration, which may in any event be absorbed in the greater requirements of ventilation. Lighting, of course, must be of sufficient intensity for reading tickets on garments. Not many vaults need the lights on for long periods, and when there are no lights on, there are no workers present. At their worst, these factors do not constitute more than a small part of the total heat load.

Not much in the way of air movement is required in fur storage vaults for equalization of temperature. Temperatures are held steady over long periods, eventually all pelts coming to the same temperature, even though closely stored. Not one degree of difference will be found anywhere within a vault. Coats are so spaced and hung by usual requirements that there is no opportunity for a coat to insulate a sun wall.

For the usual holding conditions of 40F, one third should be added to tonnage in order to obtain equipment size. This addition is not required under infrequent killing conditions of 18F low and 50F high where the compressor can run practically continuous, since this operation is neither often nor long at a time. For holding conditions, it is not desirable that the compressor run for long periods without rest. Usually, the holding operation is made but 18 out of 24 hours, therefore compressor and coil capacities must be one-third larger than required with continuous operation under killing conditions. An incidental advantage of the one-third larger size of equipment is the more rapid pull down when dropping to low temperatures.

Since furs are received but a few at a time, their reduction to storage temperature constitutes only a small part of the total heat load. When distributed over a pull down period of at least 48 hours, the pull down load becomes negligible. Refrigeration is not increased by dropping the temperature to 18F, but if anything, is slightly less. There are a number of reasons why this is so, among which are the absence of light, people and ventilation load during killing conditions.

• RECOVERY OF FLASH STEAM

More often than not, the recovery of the heat and water in flash steam pays dividends. Aside from any fuel saving, it in effect increases boiler capacity and may save plant expansion. There is less make-up water required, therefore less corrosion, and less air in the system. Too often flash steam is not recovered when it should be, but at the moment the writer is concerned more with those instances where the savings exists only on paper.

A heat balance is prepared for consideration of the question. Since this involves a lot of figures and no other experience, you assign the task to the young college fellow who is not yet far removed in point of time from that sort of thing. He does a nice job, the array of figures look too imposing to doubt, its conclusions are read and accepted, but its correct only theoretically and for the pounds of steam involved.

At this point one should do some thinking. The first question is: Why are there so many pounds of steam recoverable? Why not eliminate or at least reduce the conditions causing the flash? Let us not make any more condensate than is actually needed and let that amount be as cold as is practical. Furthermore, is it possible to use a cheaper fuel to make the amount of saving negligible?

There are so many ways of reducing the amount of flash steam, such as (1) reducing the wetness of the steam, which wetness is also inefficient in other ways, and (2) by eliminating boiler priming. Lower pressures, if practical, will decrease the amount of condensate to flash by reducing thermal losses in transit; the main

(*Continued on page* 144)

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(*Continued from page* 142)

advantage is the lower temperature of the condensate at traps when these are of a type discharging condensate close to steam temperature, therefore flashing steam. Another way, again if practical for the particular installation, is to superheat to a reasonable degree, thus making less condensate for a given heat input and again saving on thermal losses, since superheat parts with its heat less readily.

Thinking so far has only scratched the surface, but is sufficient to suggest numerous other ways of reducing flash. Less vacuum might be carried, more individual trapping substituted for group trapping, increased maintenance at traps, and adjustment of certain traps at processes to deliver condensate at lower temperature for less flash, where longer retention of condensate is not detrimental to the process. Steam might be turned off at the process as soon as possible, the same for the structure, and the structure not overheated. Possibly less air can be exhausted and less outdoor air used. More insulation might be added, even on the flanges of piping, all to reduce the pounds of steam which can flash at traps.

At slight expenditure, the number of drip points might be reduced and new traps used of the type that gives less flash, when such replacements become advisable. On new work, lifts can probably be avoided so as to reduce flash; piping used in duplicate or, for occasional use, made smaller; all pipes made smaller where possible to reduce thermal losses; and consideration given to superheat which allows smaller diameter pipes because of higher velocities, in the absence of wetness.

Generally, it does not pay to recover flash steam if the drips are too scattered. It costs too much to collect and return the condensate, especially where many flash tanks are required. Furthermore, the collecting pipes then lose too much of the heat recovered. In one case, a plant made use of a large return pipe to return the condensate, saved on new pipe, and lost on heat. Finally, there is the cost to insulate, paint and maintain all these tanks and piping. No work goes on without indirect expenses, such as that for supervision, clerical work, and interruption to plant routine, and output.

• AIR CONDITIONING BRIEFS

Commonwealth Edison Co. of Chicago reports it is burning more coal now than it did during the winter months, just because of the air conditioning load. However, it is coming to be a world wide load with even Stalin and Lenin resting in an air conditioned tomb. Most of all, the living need it and that is what the employees of Southwestern Bell Telephone Company thought when they left their work last summer as the temperature reached 100F. Needless to say, air conditioning has since been installed.

At one time discussions were quite lengthy as to which type of control was best and whatever was chosen was used exclusively in the structure for which it was selected. Sometimes I think that the occupants of air conditioned spaces would be more comfortable if the control manufacturers would omit the thermometers from thermostats on comfort job, or at least arrange them for easy removal.

It is desirable to speed up the process for cooling castings so I suppose a way will be found some day to pour molten metal into an air conditioned mold.

As for furs, air conditioning could lose out, for if there are no moths, there is no need for cold storage. The Canadian Government has been putting finishing touches to the development of synthetic fur, a nylon mothproof fabric.

Curiously enough this is being done in a country where natural fur is more abundant although duPont has been doing some experimental work along the same lines in the United States. A nylon sample coat was recently on sale in Montreal for $200. This coat is said to be washable, warm, good-appearing and to let moisture out from the body, the same as with natural fur. Although it will not burn, it will singe.

Roof cooling may add some burden to water shortages. One way to cool the roof is to take the return air back in the space above the ceiling. This does not decrease the cooling load but it does permit a higher temperature rise for the supply air. This results in smaller ducts and air handling apparatus. Air, cooled or warmed to flow through ducts conveying electrical and other services, has been proposed for floors and ceilings of multi-story office buildings, the air finally to be used for ventilation.

There are no windows or doors in a department store in Stuttgart, Germany. The store is opened by lowering the wall next to the street. Air at high pressure blown at openings keeps heat or cold out and a huge vacuum cleaner takes the dust. Incidentally, air currents have been used heretofore at doorways of restaurants, kitchens and other places to keep out dust and flies.

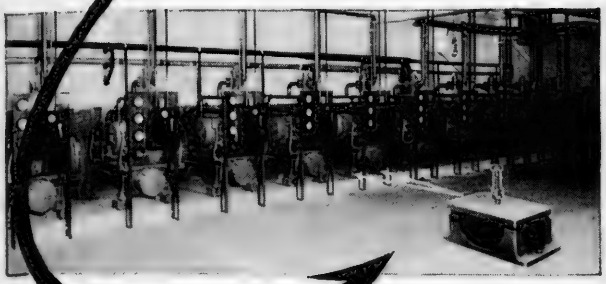
Out at McCulloch Motors in Los Angeles, employees scattered over a wide area have more lunch time left by having the cafeteria come to them. A small but adequate refrigerated and heated outfit is driven around at 5 miles per hour, come rain or shine, also during coffee hours. Construction offices are becoming air conditioned. That of the Lyons Construction Co. at Miami, Fla. consists of an old bus which has ample, well lighted quarters, easily adapted to air conditioning.

A crane cab in a smoke stack would be out of place and out of consideration, but many a cab is still unconditioned, although directly in the path of fumes and heat on their way out through roof ventilators. DuPont says that on the average, the office air conditioning load can be computed at 1 ton of refrigeration per 3 workers. This is based on body heat plus 110 sq ft of floor area per worker and 275 watts for the same area.

In the heating and air conditioning of buildings, and more particularly for the home, some thought should be given to design which will fit in to recent tendencies to make two rooms out of one, two bed rooms, for example. There are walls that can swing to make this possible, also folding doors such as made by New Castle Products, Box 467, New Castle, Ind.

The sale of air conditioned new homes can be increased if the Government would aid in mortgaging old houses when repaired by the builder of the new home. The builder could then take over the old house at estimated sale price less its estimated repair. The old house may at least offer some advantages, such as more space and shrubs and known conditions as to fire protection, transportation and schools. Incidentally, a new house should not repeat the mistake that has often been made in former houses of putting the outdoor air intake in the worst place, such as on windward side where too much air is blown in at low temperatures.

STOP VIBRATION



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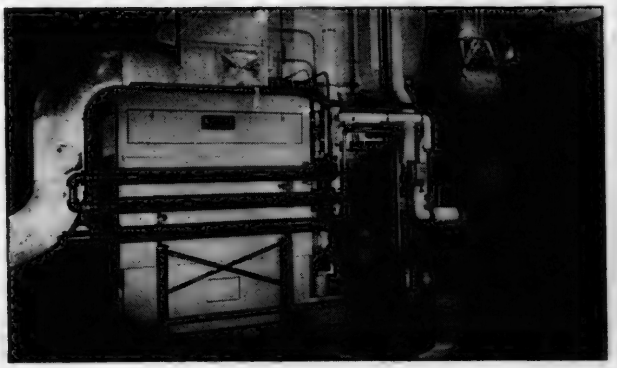

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NEWS OF THE MONTH

WATER POLLUTION CONTROL

gets increasing attention from state legislatures as waste disposal poses nation-wide problem.

A new half-million-dollar state experiment station which Massachusetts is placing in operation in Lawrence for expanded research in curbing water and air pollution paces current developments in this field reported from state capitals and municipalities throughout the country.

Scheduled for opening in early February by the Division of Sanitary Engineering of the Massachusetts Department of Health, the new building will house the experiment station activities the division has been conducting in a less adequate building in Lawrence and the water and sewage laboratory heretofore located in the State House in Boston.

The Massachusetts research station is the only one of its type operated by a state health department. The only similar research station is a new one recently opened in Cincinnati by the U. S. Public Health Service.

Clarence I. Sterling, Jr., director of the Massachusetts division, points out that the original Lawrence Experiment Station, established in 1886, was the first research station in the treatment of sewage and industrial wastes not only in this country but in the world. It was at this station that the basic principles of treatment were developed, he notes, and it was also the original training ground for the profession of sanitary engineering.

In its new, enlarged and better equipped building, the Massachusetts experiment station will have three broad functional divisions: Research in the continuing problems of environmental sanitation; service for carrying out all the laboratory examinations concerned with air pollution, shellfish and water, sewage and industrial waste treatment facilities; and training in the scientific skills involved in environmental sanitation. An entirely new venture of the new station, a state publication adds, will be the laboratory for research in the hydraulics of plumbing.

Completed at a cost approximating $517,000, the new Massachusetts building of reinforced concrete with brick trim has two stories and a basement with a total floor area of 24,600 square feet, about double the laboratory and research areas previously available.

• **INTERSTATE.**—Other current and prospective developments in the field of water pollution abatement include the drafting of a proposed Tennessee River basin interstate water pollution control compact affecting Alabama, Georgia, Kentucky, Mississippi, North Carolina, Tennessee and Virginia.

Drawn up at a December meeting in Chicago of representatives of the proposed member states, the new compact is similar to an Ohio River pact. It would establish standards on which member states could base uniform legislation against pollution of the Tennessee River. Such uniformity of legislation would prevent anti-pollution laws of one state being nullified by weak laws in another.

To become operative, the Tennessee River basin compact must be ratified by the legislatures of the member states and approved by Congress through the passage of enabling acts.

• **OHIO VALLEY.**—That such interstate action can be effective was pointed up by the Ohio River Valley Water Sanitation Commission's fifth annual report, which asserted that new pollution has been curbed, existing pollution is being decreased and the trend of half a century has been reversed by the member states—Illinois, Indiana, Kentucky, New York, Ohio, Pennsylvania, Virginia and West Virginia.

The Ohio River Valley report revealed that 43% of the sewered population of 9,319,000 in the eight-state area now receives some form of anti-pollution treatment; another 10% is building new facilities, and an additional 16% has final plans ready for construction.

Substantial quantities of industrial waste are being treated in municipal disposal plants because the majority of industries are connected in city sewers.

Among other anti-pollution developments, on a state-by-state basis, are the following:

• **CONNECTICUT.**—State Water Commission called for sewage treatment program progress reports from 11 municipalities—Willimantic, Danielson, Jewett City, Farmington, Portland, Windsor Locks, Branford, Pawcatuck, Terryville, Thomaston and Westport.

The city of Greenwich is preparing to launch during 1954 a $3,295,000 sewer expansion project which will be financed by bond issuance.

• **IDAHO.**—Although groups replying to a questionnaire sent out by the Idaho Water Resources Advisory Committee have favored the committee's proposed water pollution control law, Chairman L. J. Peterson said, some think the legislation should provide stiffer penalties.

• **KANSAS.**—An early ruling is expected from the State Supreme Court in a case testing the constitutionality of a 1953 state law giving 89 Kansas cities the power to combine their sewer and water systems into one agency.

In another Kansas development, five oil refineries in the Walnut Valley have been ordered by the State Board of Health to have water pollution abatement plans and specifications ready by Jan. 1, 1955, with a program setting forth a construction schedule for completion of the treatment facilities by July 1, 1957. The board also gave five cities in the same area deadlines for building municipal sewage disposal plants.

• **MARYLAND.**—State Board of Health recently recommended court action to force the town of Princess Anne to comply with its order to file plans for a sewage treatment plant expected to cost about $437,000. Contending that Maryland State College at Princess Anne complicates the municipal problem, town officials feel the state should pay about $112,000 of the cost.

The Upper Chesapeake Watershed Association, a civic group, has urged the State Board of Health to take action

(*Continued on page* 148)

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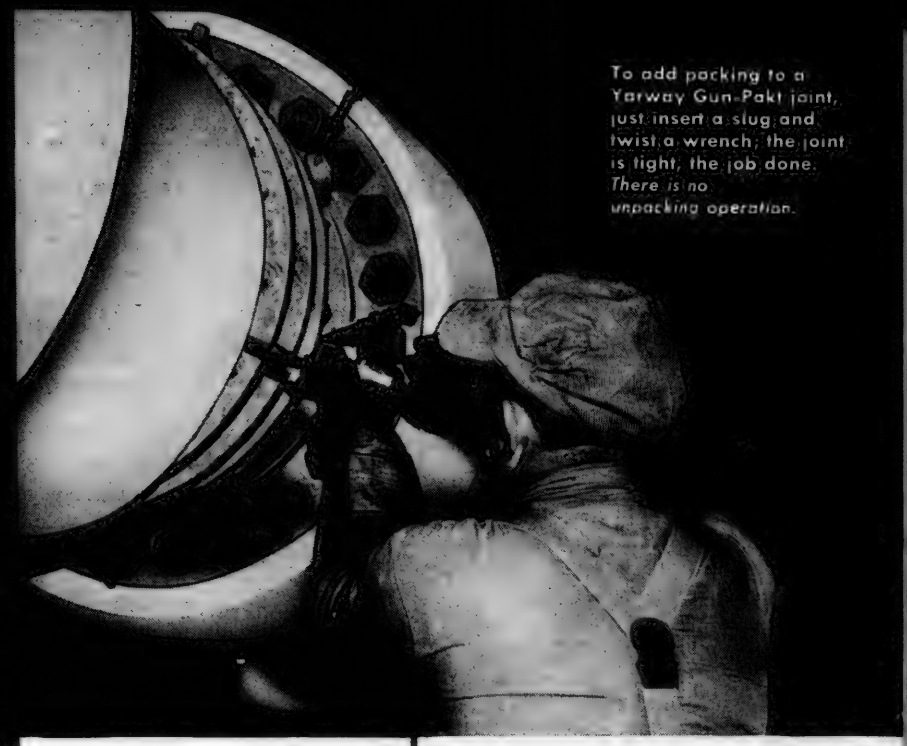

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MID-WEST AIRFIELD*	Only maintenance was lubrication and addition of 2 slugs (30 cents) of packing per year. Total labor ¼ manhour per joint per year.	Lubrication and gland tightening required 8 manhours per joint per year—plus complete unpacking and overhaul every 2 to 3 years. Time required for overhaul—20 manhours per joint.
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*Names on request.

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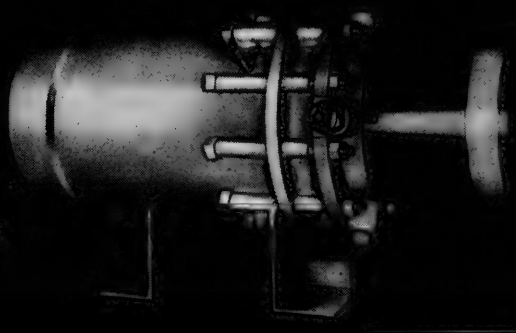

gun-pakt expansion joints

WATER POLLUTION CONTROL

(*Continued from page* 146)

against the city of Elkton's dumping of raw sewage into the Elk River at the northeast corner of Chesapeake River.

An order issued by the board called upon the town of Rockville to file plans, specifications and contracts by June 1, 1954, for more adequate sewage disposal facilities.

• **MICHIGAN.**—Following a survey of slow pollution control progress of many upper peninsula municipalities, members of the State Water Resources Commission conceded the financial problems involved were great. Commission Secretary Milton P. Adams predicted the commission would be forced to extend deadlines. Most affected communities are under a June 1, 1955, deadline. Adams pointed out that rock sheath lies just below the surface soil over most of the peninsula. It requires blasting for the installation of sewers, involving extra costs.

• **PENNSYLVANIA.**—State Sanitary Water Board has announced "outstanding progress" in its campaign to curb Susquehanna River basin pollution. Hailed as an important step in the drive was the Lock Haven City Authority's recent awarding of sewage treatment plant construction contracts.

A number of other up-river improvements under way include two sewage treatment plants being built at Williamsport at a cost of more than $3,500,000. New plants also are under construction at Jersey Shore, Lewiston, Muncy, Shippensburg, Tyrone, York and Altonna where a second plant is under way in addition to one recently completed.

The board said other new plants recently placed in operation in the Susquehanna River basin include those at Bloomsburg, Catawissa, Bedford, Everett, Columbia, Danville and Watsontown.

• **UTAH.**—Constitutionality of a 1953 state law creating the Utah Water Pollution Control Board was upheld in an opinion by State Attorney General E. R. Callister. The ruling was sought to strengthen the board in a comprehensive program it is preparing to launch.

The board has under consideration a tentative draft of "Water Classification and Standards," which will be the basis for a long-term program to prevent pollution now threatening the welfare of the state.

• **VIRGINIA.**—A court test is expected to be started early in 1954 to determine whether Virginia localities can set up sanitation authorities and then enter into agreements with other localities for joint use of the authority's facilities. The Alexandria Sanitation Authority and Fairfax County want the State Supreme Court of Appeals to decide on legal questions involved in an agreement between the two for joint use of a sewage treatment plant the authority expects to complete in 1956 at a cost of $10,408,000.

• **WISCONSIN.**—In a move regarded as setting a precedent for similar future actions, the Wisconsin State Water Pollution Committee directed the Flambeau Paper Division of the Kansas City Star Co., which operates a pulp and paper mill at Park Falls, to submit plans by the end of 1954 for a treatment plant to stop river pollution and to have the plant constructed and in operation by Dec. 31, 1956. The mill was further directed to make a progress report by July 1, 1954, and every six months thereafter.

The committee made it clear through the decision that disposal of spent sulphite liquor as a road binder during the road construction months is not sufficient to satisfy the state. More complete year around disposal of paper mill wastes will be required, the enforcement agency indicated.

The Park Falls mill case was regarded as a sign of what action the committee is likely to take on a number of sulphite paper mills which have been attempting to meet new state anti-pollution standards by hauling spent sulphite liquor for road binder and various other highway uses during the limited road construction season and putting the waste liquor into the streams during winter months.

MINERAL PRODUCTION

at new high in U. S. Fuels increase in spite of decline in coal production, Bureau of Mines reports.

Mineral production in the continental United States during 1953 was the greatest in history, according to a year-end summary released by Secretary of the Interior Douglas McKay. The summary was prepared in the Bureau of Mines.

Total value of the Nation's 1953 mineral production is estimated at $14,346 million, 7% higher than in 1952. The greatest increase was in fuels, but production of nonmetallic minerals and of metals also rose.

New highs in both physical volume and value of petroleum and natural gas production during the year far outweighed a continued decline in coal output. Production of oven coke and coal chemicals also increased considerably.

• **IRON.**—The greatest production of iron ore in history was a highlight of last year's metal mining operations in this country when shipments of 117 million long tons exceeded the 1952 figure by 20%. The availability of new shipping capacity on the Great Lakes was an important factor. In addition, production of all ferro-alloy metals mined in this country, except for cobalt, was substantially higher than during the preceding year. Domestic tungsten production, for instance, exceeded consumption, permitting additions to the national stockpile.

• **NONFERROUS.**—Soft spots appeared in mine production of nonferrous metals during 1953. Copper output was steady at an estimated 926,000 tons, about the same as in 1952. Domestic mine production of zinc, however, was the smallest since 1938, with many mines closed or running on short time, and that of lead was about 50,000 tons less than in 1952. Domestic antimony production virtually ceased, providing only about 1% of consumption, under heavy competition from imported metal.

Several Government committees were studying the problems of the zinc and lead mining industries as the year ended, preparatory to making recommendations in 1954.

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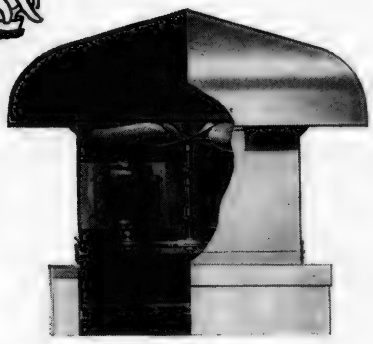

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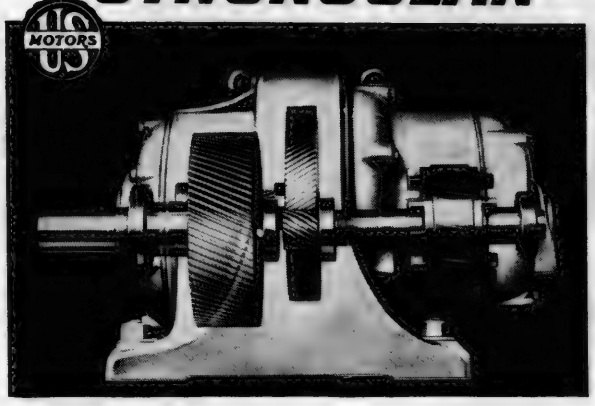

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Economy
Utility

Shortest, lightest heavy-duty tool

Greatest driving power

New series of power-sealed charges balanced to the tool

Circle-Set Shield, adjustable for 12 positions of handle

Faster, easier operation

All the family characteristics of RAMSET JOBMASTER and PLUS-POWER JOBMASTER are built into the new SUPER-POWER JOBMASTER for heavy-duty fastening into steel up to 1" thick or the hardest concrete. Ask your dealer to demonstrate the many new features which make SUPER-POWER JOBMASTER the outstanding powder-actuated tool for speed, ease, utility and economy, and show you how it takes over where all others leave off. Or, write us for details.

Ramset Fasteners Inc.
Ramset Division, Olin Industries, Inc.
12135 BEREA RD. • CLEVELAND 11, OHIO

FIRST IN POWDER ACTUATED FASTENING — AN Olin PRODUCT

MINERAL PRODUCTION

(*Continued from page* 148)

Commercial production of the new light metal, titanium, was double that of 1952. However, it still fell so far short of defense requirements that the General Services Administration contracted with the Bureau of Mines for limited production of titanium sponge.

The value of mineral production in the continental United States for 1952-53, as compiled by the staff of the Bureau of Mines, is as follows:

	1952 (preliminary)	1953 (estimate)
	Millions of Dollars	
Nonmetallic minerals:		
Fuels	$9,616	$10,189
Other	2,212	2,380
Total nonmetallic	11,828	12,569
Metals	1,602	1,777
Grand total	13,430	14,346

• **COAL.**—Bituminous coal and lignite production in 1953, estimated at 450 million tons, was down 4% from the 466,840,782 tons produced in 1952 owing to smaller exports and declining domestic consumption. The general outlook, the Bureau reported, is not favorable for maintenance of last year's rate of production.

The average value of soft coal at the mine was estimated at $4.98 a ton, compared with $4.90 in 1952.

Pennsylvania anthracite production in 1953 is estimated at 30 million tons, down 26% from 1952. The decline can be attributed partly to competition from other fuels, notably fuel oil and natural gas, and partly to comparatively mild winter weather throughout the principal anthracite marketing area. The value of 1953 production is estimated at $278 million, as compared with $380 million for 1952.

Coke production in the United States in 1953 is estimated at 79.3 million tons, up 16% from 1952 and on a par with the peak production of 1951. Over 1,000 new ovens went into operation during the year, and although many of them were replacements, the industry gained about 4 million tons of oven-coke capacity, which at the end of the year totaled about 80 million tons annually. Production of coal chemicals in most instances paralleled the increase in oven-coke output and reached about $388 million in value.

• **PETROLEUM.**—Based on preliminary data, crude petroleum producers set another record in 1953 with an output of 2,359 million barrels or an average of 6,463,000 barrels daily, up 3.3% from 1952. This production was worth $6,369 million at the wells, an average of $2.70 a barrel compared with $2.53 in 1952.

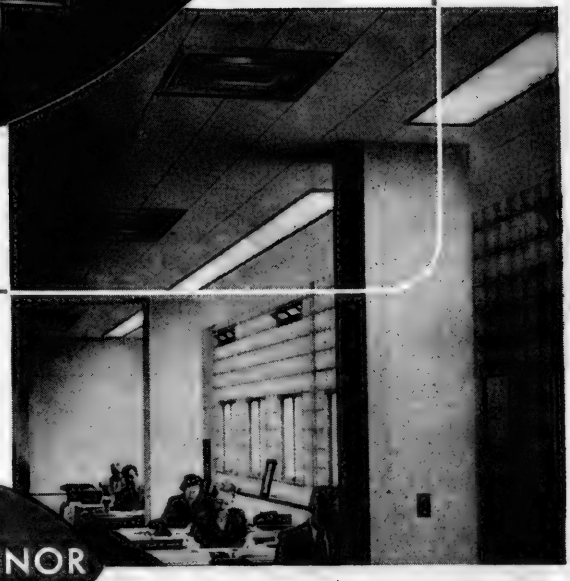
Natural gasoline production increased 5% to 127 million barrels. Prices weakened toward the end of the year and average value is estimated at 7.2 cents a gallon, slightly below 1952. Liquefied petroleum gas production increased 13% to 115 million barrels with an average value of 3.9 cents a gallon, slightly higher than in 1952.

Marketed production of natural gas in 1953 was 8,425

(*Continued on page* 152)

Round or SQUARE

You'll do 3-ways better with KNO-DRAFT



FIRST, you'll assure greater comfort. Kno-Draft Adjustable Air Diffusers control both volume and pattern of air flow. This means *even distribution* of air throughout the conditioned area—with *no drafts.*

SECOND, you'll have less "engineering" to do. The fact that Kno-Draft is adjustable for volume *after* installation means less slide rule work *before* the job goes in. And it's a cinch to reset Kno-Draft Diffusers to meet changed floor layouts.

THIRD, you'll meet highest standards of beauty. Kno-Draft Adjustable Air Diffusers unobtrusively fit into any architectural or decorative scheme. Leave them in their natural aluminum finish, or paint to match the ceiling.

For the complete story, send for your copy of the latest Kno-Draft Data Book. It's free on request. Use the handy coupon or write to Connor Engineering Corporation, Danbury, Connecticut.

CONNOR

kno·draft®

adjustable air diffusers

see our catalog in ARCHITECTURAL FILE or write for copy

CONNOR ENGINEERING CORP.
Dept. J-24, Danbury, Connecticut

Please send me the *new edition* of the Kno-Draft Data Book—without obligation, of course.

Name.....

Position.....

Company.....

Street.....

City..... Zone..... State.....

TEST of TIME

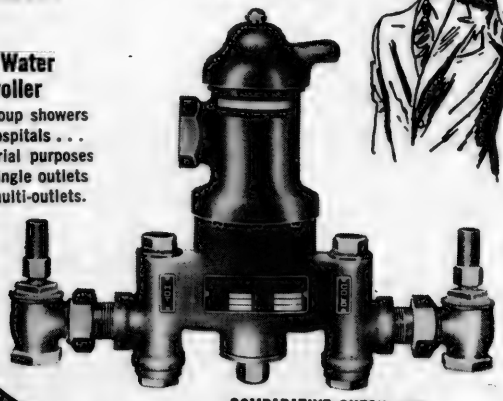
Lawler's longer-lasting Quality insures YOUR reputation!

Lawler's "Performance-Tested" design combines pioneering experience with engineering leadership. The use of specially chosen metals assures YOUR customers years of positive accurate temperature control with lowest maintenance cost . . . the best insurance YOUR REPUTATION can have!

PLATE NO. 5220

BAM Water Controller

For group showers . . . hospitals . . . industrial purposes . . . single outlets . . . multi-outlets.



Compare!

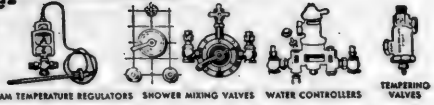
List the facts . . . Check them off . . . Lawler comes out first every time! YOUR REPUTATION is protected!

COMPARATIVE CHECK LIST

LAWLER BAM WATER CONTROLLER	Product "A"	Product "B"
Most Complete Line ✓	✓	
Hydraulic Thermostat ✓		✓
Polished Chrome ✓	✓	
Non-Ferrous Construction ✓		✓
Loose Key Angle Stops ✓		

The Lawler Line — Thermostatic Controls

"Performance-Tested" for Longer Life



STEAM TEMPERATURE REGULATORS · SHOWER MIXING VALVES · WATER CONTROLLERS · TEMPERING VALVES

LAWLER AUTOMATIC CONTROLS, INC.

453 North MacQuesten Parkway Mount Vernon, New York

MINERAL PRODUCTION

(*Continued from page* 150)

billion cubic feet, 5% greater than in 1952. The average value of gas at wells continued to rise, averaging 8.5 cents a thousand cubic feet compared with 7.8 cents in 1952.

BLUE SMOG

settles on Elizabeth, N. J. Kettering Laboratory to analyze samples as streets turn blue.

Hundreds of samples of smoggy air, collected in Elizabeth, N. J., during December by Lawrence J. Schafer and David W. Yeager of the Kettering Laboratory of Cincinnati University, were sent to the laboratory for tests to determine the cause of air pollution here.

Elizabeth was chosen as one of ten cities in the nation for tests on what is in the air of the average city.

The Kettering laboratory team, with a truckful of equipment, took the air samples in the Bayway section of the city, an industrial area near the New Jersey Turnpike, which has had a number of motor vehicle crashes attributed to smog.

• **BLUE.**—A wide downtown area of Elizabeth was blanketed early December 22 by a metallic blue precipitant that accompanied a smog attack.

Health Officer George E. Laubach said he had assigned inspectors to investigate the mysterious smog.

Hundreds of workers reported finding a strange unidentified substance that tinned streets, sidewalks and parts of factory buildings. The unusual aspect of the attack became noticeable after daylight, when streets glistened with a blue sheen. Cars and trucks made tracks just as they might in a light snow.

The smog itself was annoying, but apparently not as severe as onslaughts earlier this year. The bluish substance looked in spots not unlike an oil slick. Yet it was not oil, at least not in any recognizable form. This could be determined by scraping it with a piece of paper and noting that the paper did not turn translucent, as it would have with an oily element.

HOME COOLING

by central systems to top room cooler sales in five years, Wampler says.

Cloud Wampler, president of Carrier Corp., predicted that within five years the annual retail dollar volume of residential year-round central heating-air condition units will top that of room air conditioners. The market for air conditioners as it is known today will change its character by 1959, he said.

Speaking at a press luncheon in the New York Academy of Science, Mr. Wampler said these central units

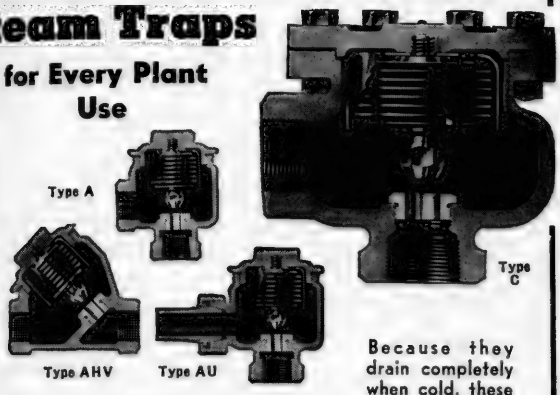
(*Continued on page* 154)

NICHOLSON MAKES

FREEZE-PROOF

Steam Traps

for Every Plant Use



Because they drain completely when cold, these four types of Nicholson steam traps are positively freeze-proof. Can be freely installed outdoors. Universally recommended for use in lines which need not be in continuous use during cold weather, because they are freeze-proof and because their 2 to 6 times average drainage capacity results in minimum heat-up time. The non-air-binding feature of Nicholson traps also notably facilitates heat transfer in severe weather.

Sizes ¼ inch to 2 inch; pressures to 250 pounds.

BULLETIN 853
199 Oregon St., Wilkes-Barre, Pa.

W. H. NICHOLSON & CO.
TRAPS · VALVES · FLOATS

For removing a LARGE VOLUME of Fumes or Air at HIGH VELOCITY

allen

VERTICAL DISCHARGE FAN

Whenever you face the problem of discharging fumes or vapors through a roof ventilator so that they will not short circuit back through building openings, you'll find the solution in this new Vertical Discharge Fan. It is designed especially for industrial applications that require the removal of a large volume at high velocity. The "VD" roof fan is fabricated of zinc-coated iron sheet with welded construction throughout. Automatic wing dampers open with air blast, close weathertight when not operating. The "VD" is available as direct drive with motor mounted inside air stream or as "VDR" with motor mounted outside throat of ventilator. Either type is available in a wide range of capacities and sizes.

Write for catalog on complete line of roof ventilators.

ALLEN ENGINEERED VENTILATION

PRODUCTION PLANNING CO.
ROCHESTER, MICHIGAN
Roof Ventilators for Every Commercial and Industrial Need

get the inside story on your **AIR FILTERS** at a glance!

HAYS AIR FILTER GAGES

With an air filter gage you measure the resistance that air meets in passing through a filter—you get the *inside story* at a glance.

A dirt-clogged filter in air circulating or air conditioning systems lowers efficiency and costs you money. Needless changing of filters to avoid clogging is expensive. A small investment in a Hays air filter gage removes this guesswork . . . results in real savings.

Models and mountings available for every air filter use—features include:

- ***easy to read***—the large dial is visible from a distance.
- ***minimum maintenance***—there is no oil to evaporate and no leveling is required.
- ***constant accuracy*** — Hays' special "slack diaphragm" retains accuracy.
- ***easy zero check***—external zero adjusting screw provided.

Gages can be furnished with contacts for flash or sound alarms or with damper controls. Portable models also available.

For complete details on Hays Air Filter Gages, write for Bulletin 54-751-12.

THE **hays** CORPORATION

MICHIGAN CITY 28, INDIANA

Automatic Combustion Control
Boiler Panels • CO_2 Recorders
Veriflow Meters and Veritrol
Gas Analyzers • Draft Gages
Combustion Test Sets
Electronic Oxygen Recorders
Electronic Flowmeters
Electronic Feed Water Controls
Miniature Remote Indicators

Popular Parts

It's easy to buy popular parts—there's no searching or complicated ordering. —Yes, popular parts are easily attained in a short time.

All accessories on Olson Heaters are of the best name and quality known to heating engineers—standard products of nationally known manufacturers.

Write for the detailed step-by-step catalog for complete information.

Olson

DIRECT FIRED HEATERS
Gas, Oil, Coal or Dual Gas and Oil

ARTHUR A. OLSON & COMPANY
BROAD STREET, CANFIELD, OHIO

HOME COOLING

(*Continued from page* 152)

represent the most promising segment of the small-unit air conditioning business. He reported that 5,000 of these units were sold in 1951; 15,000 in 1952, and 50,000 last year. He added he expected 100,000 such units sold this year and that the market would double itself in 1955 and 1956.

• **BIG.**—The Carrier president predicted that within a decade the air conditioning industry would have an annual volume of $5 billion. He reported that the industry did an estimated retail volume of $1.75 billion last year and $1.25 billion in 1952.

Mr. Wampler said homes already built represent the biggest existing single market for air conditioning sales —despite the fact that about 1,000,000 new homes are being erected each year. There are about 12,000,000 homes using warm air-heat that represent a market for central conditioners, he said.

As the home market becomes more and more competitive, air conditioning will offer a prime selling feature, Mr. Wampler said. He reported that Carrier had participated in the opening of 100 projects featuring central conditioning units, compared to twelve such participations in 1952.

INSULATION SPECS

simplified by magnesia and silica producers. Standard and double-standard designations discontinued.

Producers of 85% magnesia and diatomaceous silica insulations have adopted new simplified thicknesses for pipe insulation which will aid specification writing and permit the use of all sizes and thicknesses in double layer construction. The new thickness tables result from collaborative effort of the members of the technical committee of The Magnesia Insulation Manufacturers Association, according to Marshall F. Allen, association manager.

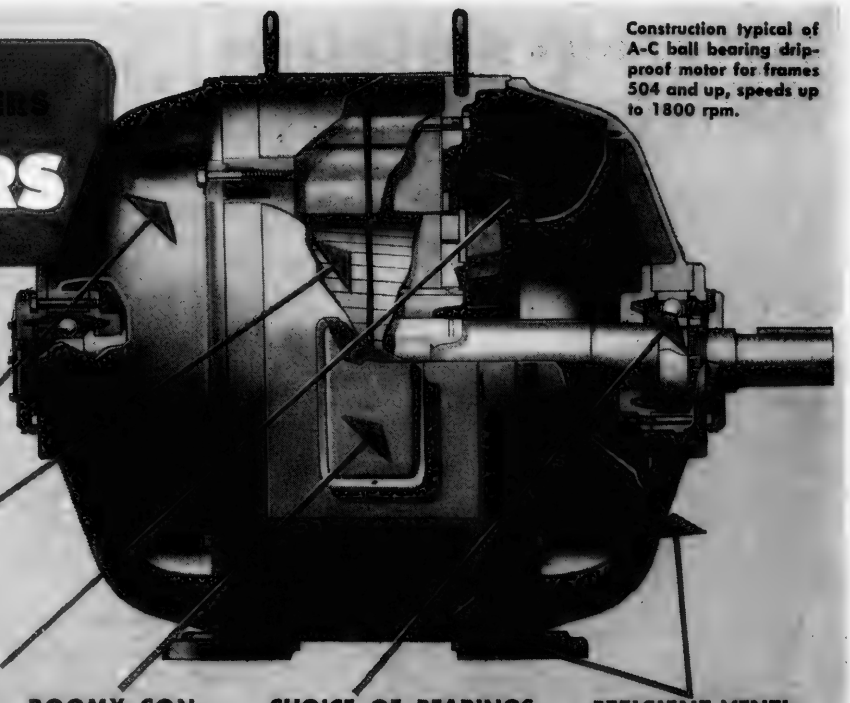
While this is, in effect, a standardization procedure, it does away with the old so-called "Standard" and "Double-Standard" thickness terminology which had been in use for many years but which has lost its significance under modern economic conditions. Furthermore, different manufacturers produced 85% magnesia in varying thicknesses in the past while under the new system all magnesia and diatomaceous silica pipe insulations will conform to the new table.

• **TABLE.**—The nominal thicknesses will start with 1-inch and step up by ½-inch increments. Actual thicknesses will depart slightly from the nominal thicknesses to facilitate double layer construction. Specification writers may specify in nominal inches with the assurance that actual thicknesses will conform to the table regardless of the source of the material. Critical engineering calculations should employ the actual thicknesses, Mr. Allen recommended.

(*Continued on page* 156)

ALLIS-CHALMERS

MOTORS



Construction typical of A-C ball bearing drip-proof motor for frames 504 and up, speeds up to 1800 rpm.

All These Features of Good Motor Design

CAST IRON END SHIELDS— assure distortion-free bearing support for maximum bearing life, correct rotor alignment, uniform air gap.

BRAZED CAGE WINDING — copper or copper alloy cage bars are brazed to end ring to produce a practically indestructible rotor winding.

STATOR COILS—multiple-dipped, baked after each dip. Build up tough protection against heat, moisture and corrosive atmosphere.

ROOMY CONDUIT BOX — has ample room for easy connection of leads, may be rotated in 90 degree steps.

CHOICE OF BEARINGS — motors may be obtained with either ball or ring-oiled sleeve bearings. Ball bearings are housing mounted with provisions for in-service lubrication.

EFFICIENT VENTILATION — large intake and discharge openings with ample-sized fan assure a sweeping flow of cooling air. Careful baffling of air flow and plenty of space back of stator core assure adequate, even cooling.

3 Extra Values

1 **Nation-Wide Certified Service** — Allis-Chalmers Certified Service Shops located throughout the country provide factory-approved parts and service on your Allis-Chalmers motors. A-C Certified Service Shops are independently owned shops that meet the strict A-C standards for modern equipment, experience, and business integrity. They provide you with prompt, economical repair and maintenance.

2 **Complete Drive From One Source** Allis-Chalmers can supply your complete drive — control — motor — *Texrope* V-belt drive — from one convenient source.

3 **Competent Engineering Help** Your local Allis-Chalmers District Office representative or Authorized Distributor will be glad to help you select exactly the right motor for your needs. For additional information, write Allis-Chalmers, Milwaukee 1, Wisconsin, for Bulletin 51B6052.

A-4227

Sold . . .
Applied . . .
Serviced . . .

by Allis-Chalmers Authorized Distributors, Certified Service Shops and Sales Offices throughout the country.

CONTROL — Manual, magnetic and combination starters; push button stations and components for complete control systems.

TEXROPE V-belts in all sizes and sections, standard and *Vari-Pitch* sheaves, speed changers.

PUMPS — Integral types from ¾ in. to 72 in. discharge and up.

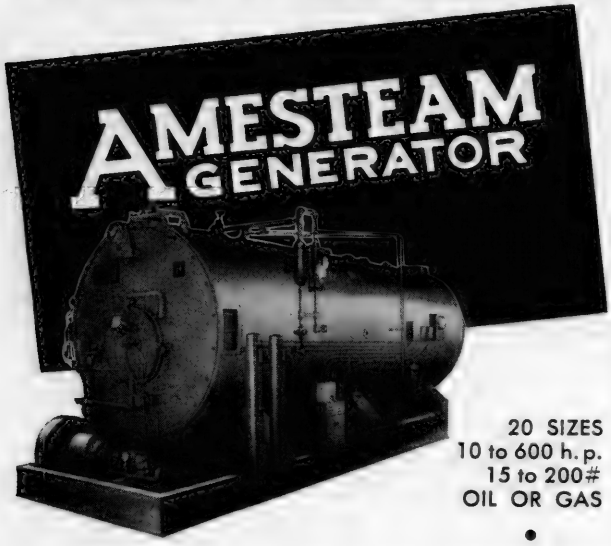
Texrope and *Vari-Pitch* are Allis-Chalmers trademarks.

ALLIS-CHALMERS

A-C ALLIS-CHALMERS

REAL SAVINGS

in installation . . . in operation with these "PACKAGED" BOILERS



20 SIZES
10 to 600 h.p.
15 to 200#
OIL OR GAS

•

JUST SET IT ON YOUR CONCRETE FLOOR — no special foundation or heavy stack are needed. You make BIG savings on installation of AMESTEAM GENERATOR because it's a complete, self-contained unit, ready to start generating steam!

FULLY AUTOMATIC . . . TROUBLE-FREE! Set it and forget it. No more continual dirt, dust and ashes. Models for oil or for gas, or combination units for either fuel.

EASY TO CLEAN! EASY TO GET AT! Davit-hinged doors at rear give quick access to furnace and all tubes — and look at the space under the shell!

COMPLETE SERVICE! Our LOCAL service man starts your unit and gives you three months' FREE service.

Write for FREE bulletin TODAY!

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Box C-24 Oswego, N. Y.
Gentlemen:
Please send me further information on AMESTEAM GENERATORS and name of nearest representative.

NAME.....
COMPANY.....
ADDRESS.....

AMES IRON WORKS INC.

INSULATION SPECS

(*Continued from page* 154)

Taking insulation for a 1-inch pipe size, as a typical instance, a comparison of the old and new thicknesses is as follows:

New Nominal Thicknesses, inches				
1	1-1/2	2	2-1/2	3
New Actual Thicknesses, inches				
1-3/32	1-19/32	2-1/8	2-21/32	3-5/32
Obsolete Standard Thicknesses, inches				
7/8	1-1/2	2	2-1/2	3

A complete conversion table covering all insulation thicknesses for all pipe sizes can be obtained from The Magnesia Insulation Manufacturers Association, 1317 F Street, N.W., Washington 4, D. C.

115 HEAT PUMPS

transferred in single record sale to Florida motel, a neighbor of previous record buyer of 49 units.

The sale of 115 heat pumps for installation in a six and one-half million dollar Miami motel-hotel has been announced by the General Electric Company.

This will be the largest single installation of heat pumps on record according to H. M. Brundage, manager of General Electric's Weathertron Department under which name the G-E heat pump is marketed.

• **NEIGHBORS.**—The motel project, called the Golden Gate development, is located on Florida highway A1A a few miles north of the Belmont Park Motel where the previous record installation of 49 Weathertrons was made in October of this year.

The Golden Gate development is located on both the ocean and the land side of the highway and will house 1500 people. It contains a shopping center, play areas, and salt and fresh water pools.

Mechanical Contractors Supply, Inc., of Winter Park, Florida, handled the sale. Igor Polevitzky is the architect.

TUBE TURNS ABSORBED

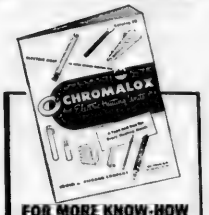
• National Cylinder Gas Co. has simplified its corporate structure. Two of four wholly-owned subsidiaries now operate as divisions and the corporate charters of the remaining two have been surrendered and their operations taken over by the parent company. Tube Turns, Inc., manufacturer of welding fittings and forgings, with headquarters in Louisville, Kentucky, has become the Tube Turns division. Pennsylvania Forge Corp. of Philadelphia, producer of flanges, rings and heavy forgings, has become a division known as Pennsylvania Forge Co. The Hollup Corp. of Chicago, and National Cylinder Gas Co.-Pacific Coast, have been dissolved. There will be no changes in the organization or method of operation of either Tube Turns or Pennsylvania Forge.

DEPENDABLE HOT AIR

CHROMALOX *Electric* HEATERS

FOR COMFORT OR PROCESS HEATING

Providing consistent, dependable hot air for space or process heating is simple when you use Chromalox Electric Heaters. Ready-to-use units are available for permanent or portable mounting; or you can build banks of heaters for specialized uses in air ducts, heat exchangers, ovens and other applications. Economical around-the-clock service with minimum maintenance; rapidly reached, accurately controlled temperatures; wide selection to meet specific needs.



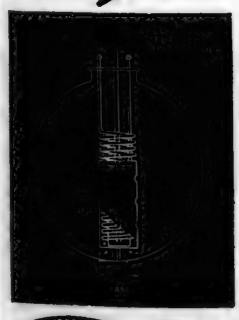
FOR MORE KNOW-HOW
Write for Catalog 50 which shows Chromalox Electric Heaters for use in offices, plants and homes.
SB-26

Edwin L. Wiegand Co., 7588 Thomas Blvd., Pittsburgh 8, Pa.

CHROMALOX
ELECTRIC HEAT FOR MODERN INDUSTRY

Solve STORAGE TANK OIL PREHEATING

REMPE "Hot Spot" PREHEATER



All-steel shell and coil assembly for preheating No. 5 and Bunker "C" oils and other liquids to proper flow temperature before they enter the suction pipe. Positive preheating by flow accumulator.

Suction pipe, inlet and outlet pipes for heating by steam or hot water go through manhole cover. Made with 14" or 16" dia. shell.

WRITE FOR DETAILS

Complete facilities for fabrication of pipe coils — all types — all materials. Engineering service. Send details for price.

HEAT TRANSFER EQUIPMENT REMPE CO. founded 1890

REMPE COMPANY

358 N. Sacramento Blvd., Chicago 12, Ill.

THIS FAN *had* TO BE SILENT

so they *isolated* it on BARRY FAN BASES

Carter's — the famous makers of fine underwear for the entire family — had to install this large ventilating blower on a mill-construction floor, directly above executive offices. From previous experience with similar installations, the plant superintendent expected plenty of complaints about vibration and noise.

The installation was made, using the new Barry custom-built vibration isolating bases — and there have been *no* complaints of any sort. At all operating speeds, the vibration of the heavy motor and fan is thoroughly isolated from the supporting floor. Even though the flooring is of relatively light mill construction, it gets no chance to act as a sounding board.

Barry fan bases are the ideal choice for the toughest jobs of isolating vibration and noise caused by any type of heating and ventilating or air-conditioning equipment. Each base is a *custom* job, specifically designed for the equipment it will carry. That is why these bases can be backed by a money-back guarantee. That is also why Carter's — with a tricky installation problem solved — is another satisfied user of Barry fan bases.

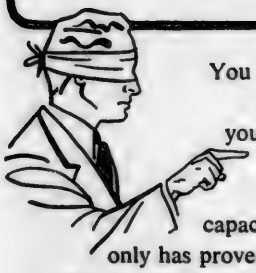
If transmitted noise and vibration is YOUR problem, we can help you. Write TODAY for your free copy of Bulletin 539.

Barry Quality

THE BARRY CORP.
712 Pleasant Street,
Watertown 72, Mass.
Sales Representatives in Principal Cities

DON'T BUY BLIND

when you *buy ventilators*



You select a ventilator on the basis of performance. *But* how can you be sure it will measure up to the claims made for it? The old practice of basing capacities on horizontal wind effect only has proved to be erroneous. THERE IS ONLY *ONE* SURE GUIDE—and that is *certified* ratings based on tests with wind coming from *any* and *all* directions as shown below. That is your best insurance against down-draft and against false ratings.

Breidert Air-X-Hausters are *certified* to provide safe, sure ventilation no matter which way the wind blows!

Stationary, no moving parts, nothing to jam or get out of order. It is not necessary to cover Breidert Air-X-Hausters with canvas to prevent drafts during winter or rainy season. The Breidert is the pioneer ventilator to publish certified ratings based on tests* made with wind blowing all directions, as shown at right.

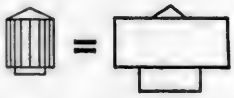
**By Pittsburgh Testing Laboratories*

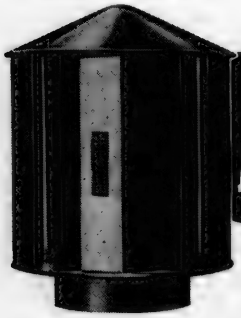
THE BREIDERT AIR-X-HAUSTER DELIVERS BETTER ALL-AROUND RESULTS

It takes fewer Breiderts to do the job than same size conventional ventilators...

OR

You can use the same number of smaller size Breiderts to do the same job as conventional ventilators.





Breidert Air-X-Hausters

PAT. NO. 2269428

GET ALL THE FACTS! Write today for complete Engineering Data Book, including certified capacity ratings. Address Dept. B.

THE G.C. BREIDERT Co.

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REPRESENTATIVES IN PRINCIPAL CITIES THROUGHOUT THE UNITED STATES

ABSTRACTS AND REVIEWS

Publications abstracted in this department should be ordered direct from publisher.

STEAM AND GAS TURBINES

Principles of both the steam and gas turbine are presented in a text book for the mechanical engineering student by John F. Lee, associate professor of mechanical engineering, North Carolina State College. As an introduction to a study of these two prime movers, the author has introduced a chapter completely devoted to a review of thermodynamics.

The objective of Theory and Design of Steam and Gas Turbines is to provide a textbook for use in the mechanical engineering curriculum and to furnish the practicing mechanical engineer with a fundamental background so that he will have a better understanding of the latest literature in this field.

Theory is critically examined and explained. A guiding principle followed by the author is to use the theory in design applications to the exclusion of empiricism wherever possible. Steam and gas turbine power cycles are treated both from the ideal and non-ideal standpoint.

Some of the chapters in this book cover steam turbine and gas turbine types, fundamentals of thermodynamics, steam and gas turbine cycles, elementary gas dynamics, design of nozzles, energy interchanges in fluid machinery, design of turbine flow passages, mechanical aspects of turbine design, steam turbine control and performance, the centrifugal compressor, the axial flow compressor, combustion, the regenerator, and the gas turbine power plant.

Theory and Design of Steam and Gas Turbines, by J. F. Lee. Cloth bound, 6 x 9 inches, 502 pages. Published by McGraw-Hill Book Co., 330 W. 42nd St., New York 36, N. Y. Price, $9.

ESSENTIALS OF ENGINEERING THERMODYNAMICS

Herman J. Stoever, professor of mechanical engineering, Iowa State College, had previously written Engineering Thermodynamics, a textbook for a full year course in this subject.

For the benefit of those who have to conduct a one semester course in thermodynamics, he has written Essentials of Engineering Thermodynamics, which is an abridgment of his earlier book.

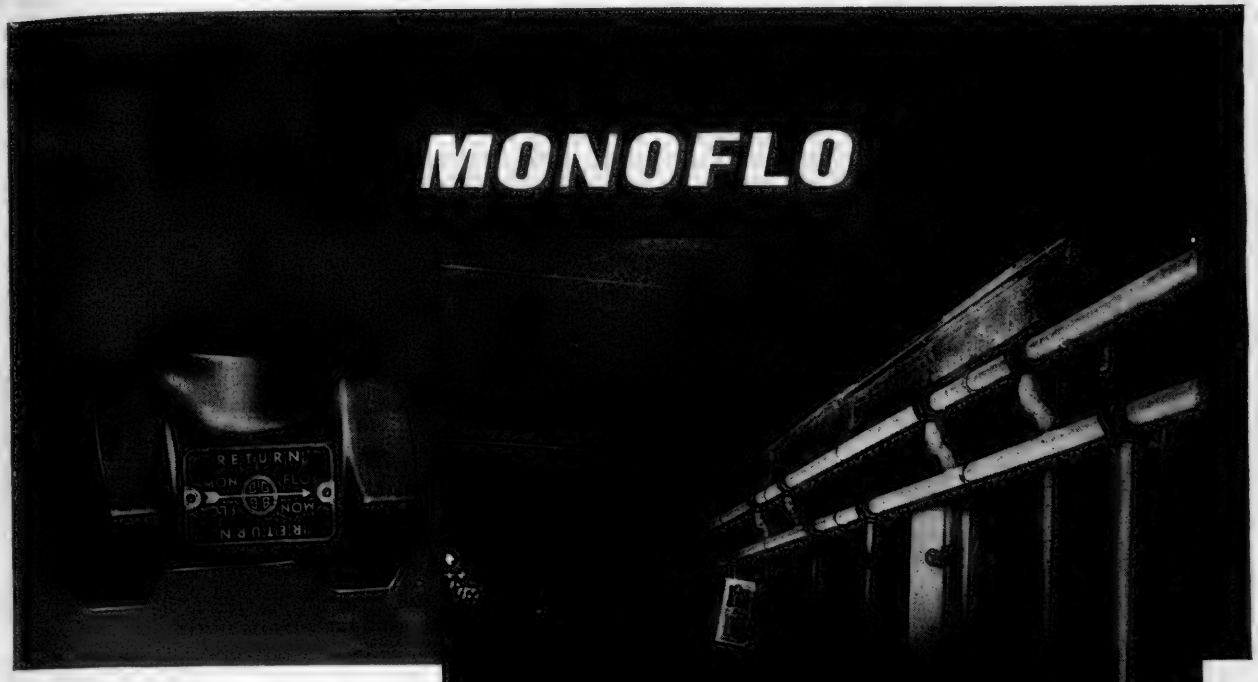
Essentially the book is divided into three parts: Part 1, the first law of thermodynamics; Part II, the second law of thermodynamics, and Part III devoted to applications of the principles and methods developed in the first two parts of the book.

A large number of problems are included, many from Engineering Thermodynamics. A number of straightforward problems is included to meet the more rapid pace followed by a course of this nature. Of the 381 problems 50 have been prepared specially for this book.

Each of the chapters in Part III is complete in itself so that each can be used independently of the others as the instructor desires. This part of the book covers steam

(*Continued on page* 160)

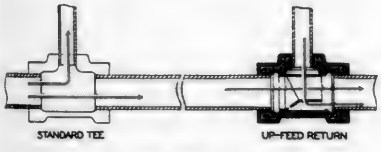
MONOFLO



B & G MONOFLO FITTINGS ASSURE CORRECT AND EFFICIENT CIRCULATION IN ONE-PIPE FORCED HOT WATER SYSTEMS

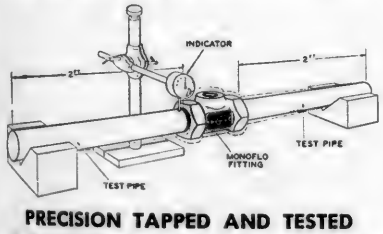
The B & G Monoflo Fitting is not just a "scoop" or "choke"! It is an *engineered* device—designed to handle definite radiator sizes, maintain proper temperature drops and permit use of economical riser sizes.

This Fitting induces flow into the heating units without penalizing the pump with excessive resistance. It assures the correct distribution of warm water, either above or below the main.



ONLY ONE MONOFLO FITTING NEEDED IN MOST CASES

Under average conditions, a single Monoflo Fitting per heating unit provides ample diversion capacity. Special down-feed Fittings are not required—simply revolving the Fitting changes it from up-feed to down-feed.



PRECISION TAPPED AND TESTED

B & G Monoflo Fittings are made by machines especially designed for the purpose, which tap the threads with extreme precision. Fittings are tested for accuracy in the sensitive gauge illustrated above. Hence installation is always easy, with no "cranking" of pipes.

In the pottery plant drying room illustrated above, a B & G Monoflo Forced Hot Water System is overcoming many former operating difficulties.

The previous method of drying the pottery was a rather complicated system of ducts carrying heat under the racks. The process was difficult to control, expensive to operate and caused a large number of rejects.

In the new method, a down-feed Monoflo System supplies heat to pipe coils under the pottery. After a year's operation, the management reports that the system is doing everything expected of it and more. The number of rejects has been drastically reduced, operating cost is lower and the process control greatly improved.

The simplicity of Monoflo piping and the desirable control qualities of the system are amply demonstrated in this novel installation.

Send for complete story of B & G Monoflo Fittings

Contains simplified design instructions for Monoflo Forced Hot Water Heating Systems in smaller installations.

BELL & GOSSETT
COMPANY
Dept. DH-4, Morton Grove, Ill.
Canadian Licensee: S. A. Armstrong, Ltd., 1400 O'Connor Drive, Toronto, Canada

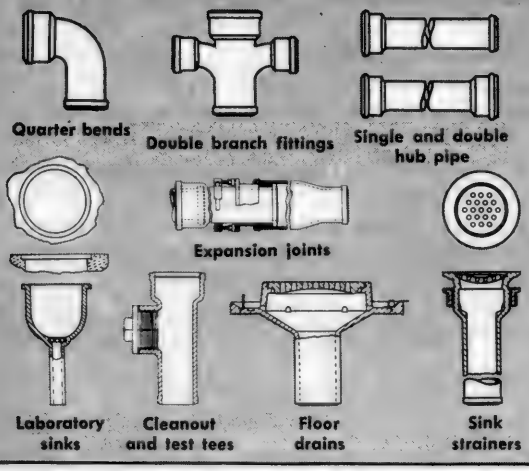
The permanent drain pipe installed by ordinary plumbing methods

DURIRON ACIDPROOF DRAIN PIPE AND FITTINGS

Duriron is a high silicon iron alloy highly resistant to most commercial acids at practically all temperatures and concentrations. It is not a coating—the entire thickness of the pipe wall is resistant to abrasion and erosion as well as to corrosion.

The labor cost of installing Duriron is the same as with ordinary cast iron soil pipe. Normally the initial cost is the final cost since Duriron will generally outlast the building in which it is installed.

SOME OF THE MORE THAN 60 STANDARD DURIRON FITTINGS



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402 North Findlay Street

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DURIRON

LOOK FOR THE NAME ON EVERY PIECE

(*Continued from page* 158)

power plants, internal combustion engines, refrigeration, compressors, nozzles, and air conditioning.

Essentials of Engineering Thermodynamics, by H. J. Stoever, Cloth bound, 6 x 9 inches, 279 pages. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. Price, $4.50.

• • •

HEAT EMISSION CHARACTERISTICS OF WARM-AIR PERIMETER HEATING DUCTS—The results of an investigation conducted in the floor slab laboratory of the University of Illinois, Engineering Experiment Station, is presented in bulletin series No. 412. This investigation was conducted in cooperation with the National Warm Air Heating and Air Conditioning Association. Studies were made to determine temperature distribution and heat emission at the floor surface, temperaure drop of air flowing through ducts embedded in the concrete floor, effect of windows on the temperatures in the rooms, air delivery into rooms through registers, effect of floor coverings on heat transfer characteristics of the floor slabs, and also heat transfer lag. The Enginering Experiment Station, University of Illinois, Urbana, Ill. Price, 80 cents.

WHAT READERS SAY

Piping Arrangement for Heating Coil

EDITOR, HEATING AND VENTILATING:

I was interested in reading your December issue of HEATING AND VENTILATING and reviewing the diagrammatic sketches on pages 9 and 10 covering typical piping arrangements for heating coils, particularly the sketch showing piping arrangement for heating coils working under vacuum system with graduate or modulating control of the steam supply.

In this arrangement your author recommends a ½-inch check valve bypass around the combination float and thermostatic trap on the return from the coil, the check valve installed with the flapper opening towards the coil.

My experience with these coil heaters, particularly the non-freeze tube type, has been that when the steam supply is modulated and cold air is being passed through the coils, that a high induced vacuum is created far greater than the vacuum being created by the vacuum pump. The condensate is accordingly held back in the coil and then when the steam supply valve begins to open and the entering steam comes in contact with the withheld condensate, a hammering takes place until the retained or induced vacuum is released and the condensate passes out of the heating coil.

I have tried the suggested method of the check valve in bypass around the float and thermostatic trap but have not noticed much change in the conditions differing from not having this check valve bypass. The thermostatic element in the combination trap does in a way permit equalizing the vacuum between that being created within the

(*Continued on page* 162)

HEATING AND VENTILATING'S

Ad-Digest SERVICE

Below and on the following pages are given brief digests of the advertisements appearing in this month's issue. Use this Digest to locate and refer to the advertisements in which you are particularly interested, then fill out and mail the prepaid postcard to request further information from manufacturers.

NOTE: While every attempt is made to list all advertisements, those which are received after the published closing date may not appear. The Index of Advertisers lists all the advertisements in this issue.

HEATING SPECIALTIES. Page 39. A firm in Pennsylvania which specializes in school construction equips all its schools with this company's line of traps, temperature regulators, water blenders, and heating specialties because they have given satisfactory dependable service throughout the years. Information available.....Item 201

UNIT HEATERS. Page 166. Horizontal type steam and water unit heaters with capacities up to 272,000 Btu per hour and vertical types up to 575,000 Btu per hour capacity. .....Item 202

PACKAGED BOILERS. Page 156. Real savings in installation and operation with this line of packaged boilers in twenty sizes. They are set on the concrete floor and require no special foundation or heavy stack. Bulletin available. .....Item 203

HEATING SYSTEM. Page 61. A new heating system which has been thoroughly tried in the field and with which there is individual room control. Steam fed to room units drives small steam turbine which in turn drives fan giving forced convection over the compact steam coils. Temperature can be varied in every room to fit the activity and personal preference of room occupants. Booklet available. .....Item 204

PACKAGED BOILERS. Page 59. All over the country steam and hot water requirements for schools are being supplied by these packaged automatic boilers which have an outstanding record of reliability and economy. They are also the best buy for hospitals and industrial plants. Bulletins available. .....Item 205

ACIDPROOF PIPING. Page 160. Acidproof drain pipe and fittings of high silicone iron alloy resistant to most acids in practically all temperatures and concentrations. Not a coating. Bulletin available. .....Item 206

AIR EXHAUSTERS. Page 158. A line of ventilators with certified ratings which provide sure ventilation no matter which way the wind blows. It takes fewer of these units to do the job. Engineering data book available. .....Item 207

UNIT HEATERS. Page 127. A line of gas-fired unit heaters with stainless steel heat exchangers and burners of half the weight and half the size of other gas units, making installation easier and less expensive. Bulletin available. .....Item 208

PIPE HANGERS. Page 27. This company has a stock pipe hanger for every piping requirement. Swivel pipe ring type is illustrated and described. This is available in 12 sizes up to 8 inches. .....Item 209

AIR DIFFUSERS. Page 28-29. How this line of air diffusers was used throughout Southern Methodist University in that institution's comprehensive program for air conditioning classrooms. They provide helpful, comfortable, draft-free atmosphere. Data bulletin available. .....Item 210

COAL FOR HEATING. Page 133. How an office building in Wisconsin cut its coal bill 20% by installing automatic controls on its modern coal heating installation. Coal is still in most places the lowest cost fuel. Case histories available. .....Item 211

AIR CONDITIONING. Page 7. As with turtles, slow speed means long life in air conditioning units. Slow speed is a feature of this company's line of compressors, conditioning units, and self-contained air condensers. .....Item 212

DIAPHRAGM VALVES. Page 40. Costly loss of welding gases in a New Orleans shipyard was traced to conventional packed valves. The remedy was a packless diaphragm valve which has stopped the leakage and eliminated costly maintenance so that the cost for welding gas has been sharply reduced. .....Item 213

HOT WATER SPECIALTIES. Page 36-37. This company's new hot water line enables this company to simplify your estimating, ordering and installing since all the equipment for hot water heating systems except the boilers can be delivered by one company. New line includes circulators, relief valves, air vents, separators, circulator valves, reducing valves, divertors, controls, balanced fittings, distributor heads and other specialties. Literature available. .....Item 214

MOTOR CONTROLS. Page 60. How the blowers for an air cleaning system in a repeater station of American Telephone and Telegraph is under the control of this company's motor controls. They require no regular attention, are trouble-free, and have only one moving part. Bulletin available. .....Item 215

UNDERGROUND INSULATION. Page 18. A modern monolithic insulation for single pipe to the most complex multiple pipe underground installations. It forms a safe, solid protection without joints or voids, and is adaptable, economical, efficient, permanent and readily available. Booklet available. .....Item 216

COMBUSTION CONTROL. Page 55. Records show that chances are 4 to 1 you are not protected against explosion hazards if you burn fuel for heat, power or processing. A booklet on flame-failure explosions, a non-technical explanation of the subject, is available. .....Item 217

WEATHER MODULATED CONTROL. Page 73. A weather modulated control system in connection with which the manufacturer has an all-out engineering service with complete installation drawings and wiring diagrams backed up by on-the-job help. Information available. .....Item 218

Circle numbers corresponding to the advertisements in which you are interested, print your name and address clearly. Information will be sent directly from manufacturers.

PLEASE SEND US MORE INFORMATION.

Circle below item numbers on which you wish further information.

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299	300	301	302	303	304	305	306	307	308	309	310	311	

PLEASE PRINT Feb. H-

This service available only to U. S. and Canadian readers

Name .....**Title**.....

Firm .....

Nature of Firm's Business .....

Street .....

City ..... **Zone** ..... **State**.....

Ad-Digest SERVICE

BLOWERS. Page 62. Ventilation was a major factor in planning a large hospital for which this line of blowers was selected because the air handling equipment had to be dependable and quiet in operation; the health and comfort of the patients demanded these features. If you have an air handling problem, get in touch with this company's nearest office. ----Item 219

HERMETIC MOTORS. Page 46. A line of motors designed specifically for driving hermetically sealed-in compressor units. These motors give extremely long life with exceptionally little trouble and are backed by six years of motor building experience. Information available. ----------Item 220

EVAPORATIVE CONDENSER. Page 167. Water can become a real headache when there is a shortage, when rates are expensive, or when sewage and pipes are impractical in connection with air conditioning. This line of evaporative condensers is available in sizes from 3 to 100 tons. ----------Item 221

ELECTRIC PRECIPITATION. Page 54. In Big Bertha, the world's largest drier, used by a sensitive paper manufacturer, positive control of air flow and air cleanliness was accomplished by use of this company's electric precipitator and fans. Company offers a complete line of air handling, air conditioning and air cleaning equipment. ----------Item 222

AXIAL FLOW FANS. Page 19. How a West Coast quick-freezing plant uses 24 axial flow fans to force cold air to the freezing floor, handling 484,000 cfm of air. Fans are quiet, light in weight, compact, and have low power consumption. Information available. ----------Item 223

PACKAGED AIR CONDITIONING. Page 65. This company's packaged air conditioner has radial design compressor coils which steps up cooling efficiency and grille which provides a greater range of adjustment of the air flow pattern. These are among the features of this line which has seven other advantages. Information available. ----------Item 224

STEEL PIPE. Page 72. This company's steel pipe is recommended for hot water or steam heating, fire control and plumbing lines, radiant heating or snow melting systems. It is uniform throughout, threads and cuts easily, bends well, makes sound joints, is scale-free, and has other advantages. ----------Item 225

DUST COLLECTORS. Page 149. The type dust collector described here is the lowest price in its class due to production economies, requires less space, but has outstanding performance. Technical bulletin available. ----------Item 226

PUMPS. Page 35. A line of air conditioning pumps which saves in engineering time as well as installation time and with no extra parts to buy. Line includes a packaged pump for air conditioning and refrigeration, a close coupled pump, and a vertically-mounted pump. --------Item 227

MOTORS. Page 155. This line has all the following features of good motor design, cast iron end shields, brazed cage welding, stator coils multiple dipped, roomy conduit, choice of bearings and efficient ventilation. Further, a complete drive of control motors and V-belt is available from this one manufacturer. Bulletin available. ----------Item 228

COPPER TUBE. Page 121. A large contracting firm in Baltimore has over 10,000 satisfied home owners attesting to the qualities of this line of copper water tube, preferred because it is easy to bend, comes in handy lengths, will take solder or compression fittings, and is non-rusting. Technical advisory service available. ----------Item 229

VENTILATORS. Page 153. For removing large volumes of fumes or air at high velocity, this vertical discharge fan will not short circuit back through the building openings. Designed especially for industrial applications with large volumes at high velocity. Made in two types. Catalog available. ----------Item 230

INTEGRAL FURNACE BOILER. Page 67. A boiler which has a capacity of almost one and one-half million pounds of steam for building heating and allied services. A shop-assembled unit, with users in a broad range of industrial, commercial, institutional and other classifications. Automatic control and efficient handling of variable loads are among the features of this steam generator. Bulletin available. ----------Item 231

COPPER TUBE. Page 68. For better drainage lines, this company's copper tube with solder joint fittings for waste, vent and soil lines can be installed rapidly, economically, do a better drainage job and last longer. It gives a light-weight drainage system. ----------Item 232

AIR FILTERS. Page 48. This company makes seven dry-type air filters, the reason being that these seven different types are each designed to meet the complex combination of factors facing the engineer in solving dust and contamination problems. This comprehensive line offers the engineer maximum flexibility. Descriptive literature available. ---Item 233

FIRE PROTECTION EQUIPMENT. Page 161. A proved reliable, economical line of interior fire protection equipment. Line includes 480 cabinets alone. ------Item 234

COOLING TOWERS. Page 30. A line of cooling towers with Koppers pressure creosoting used on all wood employed in the construction of the towers. This preservative protects the tower against fungus and marine parasites and preserves the timber. Towers made in sizes from 2 through 100 tons. Catalogs available. ----------Item 235

FREON COMPRESSOR. Page 66. Years were spent in developing this new Freon compressor of which the features include the trim, sturdy construction, easy removal of gas strainer in the suction line, operating efficiency and high capacity. Information available. ----------Item 236

UNDERGROUND PIPE INSULATION. Page 3. A triple-zone insulation for lifetime protection of hot underground pipes. The first zone is a dense semi-plastic core of the insulant which is fused on by the pipe's own heat; zone 2 is a sintered zone of the insulating particles, while zone 3 is unfused insulation providing a final margin of thermal insulation with a high load carrying capacity. Descriptive literature available. ----------Item 237

STEEL PIPE. Page 22. A continuous weld pipe of low alloy steel, whose nickel-copper content gives it ability to withstand corrosion, abrasion and shock. These advantages, combined with high strength, ductility, and weldability, make this an excellent selection. Bulletin available. ----------Item 238

STEAM TRAPS. Page 153. Freeze-proof steam traps for every plant use. They drain completely when cold, and are made in four types. They have 2 to 6 times average draining capacity which results in minimum heat-up time. Bulletin available. ----------Item 239

AIR DIFFUSERS. Page 165. Square and rectangular diffusers to provide draftless air distribution from any location. Custom-designed with built-in diffusing vanes in a wide variety of louvered patterns, they provide blows in 1, 2, 3 or 4 directions without use of blank-offs. Catalog available. ----------Item 240

DIAL THERMOMETERS. Page 161. These thermometers are made in 3 types—rigid stem, wall-mounted, and flush-mounted to meet all requirements. Technical bulletin available. ----------Item 241

AIR HANDLING EQUIPMENT. Page 71. This company's line, with certified NAFM ratings, includes roof ventilators, blowers, furnace fans, unit heaters, propeller fans, universal blowers and air conditioning units. Catalogs available. ---------Item 242

FANS. Page 43. It is important to maintain the balance of a fan wheel and an example is cited of an exhaust fan delivering dust laden air to a cyclone which gradually developed vibration and finally damaged the bearings. This company's representative advised the owner to clean the rotor every six months, then check wheel balance. Fan has since operated smoothly. This is one of the problem-solution case histories accumulated in this fan manufacturer's file. ----------Item 243

COOLING TOWERS. Page 41. This line of cooling towers features open gravity flow distribution, one fan pulling air uniformly through two open sides, vital tower parts within full view and completely accessible and a low silhouette which complements the appearance of any type building. Bulletin available. ------Item 244

ELECTRIC HEATING. Page 157. Electric heaters for comfort or process heating available in ready-to-use units for permanent or portable mounting. Application catalog available. ----------Item 245

AIR CONDITIONING AND REFRIGERATION. Page 32. A full line of air conditioners, refrigeration compressors, condensing units and other cooling equipment available from this company which has been a leader in the field for over 50 years. ----------Item 246

AIR FILTER. Pages 10-11. A one-inch air filter, which filters half-again as much clean air because it has 50% greater capacity and gives sustained efficient performance with low pressure loss and can be used at either high or low velocity. Performance charts are shown. This filter opens up exciting possibilities in many fields. Information available. ----Item 247

POWER FASTENING. Page 150. A heavy-duty power fastener designed especially for plumbing contractors. This powder actuated tool has speed, ease of use, utility and economy in fastening into steel up to one inch thick to the hardest concrete. Information available. ----Item 248

EXPANSION JOINTS. Page 147. An expansion joint for pipe lines which is packed with a gun by simply inserting a slug and twisting a wrench. There is no unpacking operation. Case histories are cited. Made in single-end and double-end types. Information on how these joints save you maintenance money available. ----------Item 249

HEAT EXCHANGERS. Page 141. These heat exchangers have electronically rolled expanded joints, tubing held rigidly apart by separators, baffle designed for rapid heat transfer, and head passes designed for free flow and minimum pressure drop. Catalog containing selection charts available. ----------Item 250

PACKAGED BOILERS. Page 52. Ten points you should look for when selecting a packaged boiler are enumerated. This line of boilers is of two-pass design, factory tested before shipment, even heat transfer, and with free and rapid water circulation, high carbon dioxide and low stack temperatures. Information available. ----------Item 251

Postage Will be paid by Addressee

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HEATING AND VENTILATING

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NEW YORK 13, N. Y.

TEMPERATURE CONTROL. Pages 124-125. Custom temperature control means that whatever your client's control requirements, this company's line is comprehensive enough and it's so designed as to fit the needs of the building and its occupants. Company makes all three types of controls—pneumatic, electric and electronic for heating, cooling, ventilating and humidity. Case history of a Florida bank presented. Information available. **Item 252**

FAN BASES. Page 157. Custom-built vibration isolating fan bases which thoroughly isolate the motor and fan from the supporting floor at all operating speeds. Each base is a custom-designed job. Technical bulletin available. **Item 253**

VACUUM PUMPS. Page 69. These vacuum pumps have a peak water capacity at 280% of rating. They automatically remove air and water from heating units, maintain a vacuum in the return, and deliver condensate to the boiler. Available in capacities from 2,500 to 100,000 square feet of radiator. Catalog available. ----- **Item 254**

AIR FILTERS. Page 164. These filters are popular because they are designed for an approach velocity of 530 fpm over the net media area and have a high filtering efficiency which increases as the dust load is applied. One-third is saved in space required and in number of units to be installed and serviced. Cost comparison chart available. ---------- **Item 255**

AIR CONDITIONING EQUIPMENT. Page 131. Evaporative condensers up to 260 tons of refrigeration and cooling towers up to 225 tons of refrigeration. There is a factory-assembled condenser or cooling tower in a size that will fit your job exactly. ---------- **Item 256**

FLUSH VALVES. Page 9. A handbook and catalog on flush valves with 19 pages of installation details for exposed, concealed, and special flush valve installations and with over 75 blueprints. Copies available. ---------- **Item 257**

WATER CONTROLLER. Page 152. A water controller for group showers, hospitals, and industrial purposes. A feature of the line is the low maintenance cost. **Item 258**

SMALL MOTORS. Page 141. The next time you are up against a tough application problem involving low range power, take advantage of this company's customer engineering service. Motors up to 1/6 hp, small blowers up to 280 cfm with controllers. ---------- **Item 259**

PUMPS. Page 49. Vacuum and condensate pumps in a line of five types, one for boilers up to 150 pounds, one for pressures from 10 to 20 pounds, two vacuum pumps, and one for pressures from 10 to 75 pounds. Bulletins available. ---------- **Item 260**

AIR CONDITIONING. Page 169. A firm which engineers and manufactures a complete line of high quality refrigeration and air conditioning equipment. ---------- **Item 261**

PACKAGED BOILERS. Page 38. A packaged boiler with extra features including all the design features offered by conventional boilers plus other features including water-cooled furnace, larger lower drum, centrifugal fan, and simple baffle arrangement. Bulletin available. **Item 262**

CONVERTERS. Page 129. How a converter was used in connection with snow melting for the sidewalks at the John Hancock Mutual Life Insurance Co. building in Boston. The converter has the capacity to heat 225 gpm of 50% ethelyene glycol solution. This company specializes in heat exchange equipment. ---------- **Item 263**

RESIDENTIAL AIR CONDITIONING. Page 162. A remote type, air-cooled condenser that completely eliminates water, sewerage and plumbing problems in connection with residential applications of air conditioning. Bulletin available. ---------- **Item 264**

UNIT HEATERS. Page 51. A full line of unit heaters including an all-purpose horizontal unit for most heating requirements, a gas-fired unit with horizontal delivery, a vertical type steam and hot water unit for use above craneways or other high-ceiling installations, and a cabinet type for lobbies, vestibules and similar installations. Information available. -- **Item 265**

GAS BOILER. Page 45. A cast iron gas boiler of compact size and high efficiency, equally at home in rumpus room or boiler room, easily assembled, easily serviced, and of moderate initial cost with abundant hot water and long life performance. Information available. ---------- **Item 266**

PACKAGE STEAM GENERATOR. Page 15. A packaged boiler for light oil, and light oil and gas, heavy oil, heavy oil and gas, natural or manufactured gas. Designed for factories, stores, hospitals, apartments, office buildings, wherever high efficiency heating and power are a special consideration. Bulletin available. ------- **Item 267**

FAN VENTILATOR. Page 149. A fan ventilator of low height and of modern engineering design which, due to its arrangement, is inconspicuous in use, easily installed and serviced, and versatile. Available in a wide range of sizes from 12 to 60 inches in diameter. Bulletin available. ---------- **Item 268**

GEARED MOTOR. Page 149. An electric motor that internally gears its speed so that the expense of installing a gear box is not needed. Eighteen advantages are listed. Available in sizes from ¼ to 30 hp. Information available. ---------- **Item 269**

OIL FIRED HEATING EQUIPMENT. Page 24. A 51-year old organization with a full line, including oil and gas furnaces and boilers, conversion burners, horizontal furnaces, industrial burners and packaged units. Information and specification sheets available. ---------- **Item 270**

TEMPERATURE CONTROL. Back cover. An insurance company installation which illustrates the adaptability of this company's automatic temperature control. 202 heating-cooling thermostats operate valves which regulate the hot and cold water that is supplied to the room air conditioning units. Information available.------- **Item 271**

GLASS FIBER INSULATION. Page 42. Glass fiber insulating wool for wrapping ducts, piping or any other application where a blanket type insulation can be used for all jobs from sub-zero to 400 degrees F. Folder and samples available. ---------- **Item 272**

HEAT PUMPS. Page 56. How a Florida church is year-round conditioned by the use of this heat pump which will produce 60 tons of cooling and a heating output of 765,000 Btu per hour. Information available. ---------- **Item 273**

Use this Digest to locate and refer to advertisements appearing in this issue of HEATING AND VENTILATING, then fill out and mail the prepaid postcard to request further information.

STEAM GENERATORS. Page 63. A factory assembled and tested steam generator with a guaranteed efficiency of more than 80%. Fully automatic, with heavy iron base, with all inter-connecting piping and wiring completed at the factory. Catalog available. ---------- **Item 274**

BLOWER VENTILATORS. Page 161. Blower ventilators of the roof type or of the wall or kitchen exhaust type. Available in three models with backwardly inclined impeller and of non-overloading characteristics. Information available.----- **Item 275**

CONDENSING UNITS. Page 21. Whether it's a room air conditioner, a large package unit, or a huge factory system, this hermetic compressor is recommended. It is available in air cooled types from ¼ through 3 hp and in water cooled types from 1/3 through 7½ hp. Condensed catalog available. ---------- **Item 276**

ELECTROSTATIC AIR FILTER. Page 48. The first washable self-charging electrostatic filter which picks up particles as small as some of the solids in cigarette smoke, looks and installs like regular replacement filters but can be quickly washed off. Whenever you need clean air these units will do the job. Information available. ---------- **Item 277**

AIR CONDITIONING AND REFRIGERATION. Page 44. A complete line of air conditioning and refrigeration equipment including evaporative condensers, packaged air conditioners, condensing units, residential units, and room coolers. Franchises available. ---------- **Item 278**

GAGE. Page 169. An extremely versatile gage which serves as air filter gage, static pressure indicator, draft gage, or air velocity meter. Has ranges from 0 to 3 inches and 0 to 7 inches of water. Of attractive design in plastic housing. Bulletin available. ---------- **Item 279**

BOILERS. Page 128. Every building from large skyscrapers down to the smallest home can have heat from these steel boilers. Every boiler in the line is characterized by simple installation, low fuel consumption, and long service life. General catalog available. ---------- **Item 280**

TRAPS. Page 50. A float and thermostatic trap with which repeat orders are the rule because of its absolutely dependable, trouble-free performance in removing all air and condensate from steam mains, branches, risers, unit heaters, coils, and similar equipment. A feature is the diaphragm that closes the valve immediately in the presence of steam. Catalog available. ---------- **Item 281**

Circle numbers corresponding to the advertisements in which you are interested, print your name and address clearly. Information will be sent directly from manufacturers.

PLEASE SEND US MORE INFORMATION.

Circle below item numbers on which you wish further information.

201	202	203	204	205	206	207	208	209	210	211	212	213	21
215	216	217	218	219	220	221	222	223	224	225	226	227	22
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AIR FILTER GAGES. Page 153. A dirt clogged filter in air circulating or air conditioning systems lowers efficiency and costs money. This air filter gage, which is easy to read, and has minimum maintenance, measures the resistance that air meets in passing through the filter and calls your attention to a filter that needs attention. Bulletin available.....Item 282

VIBRATION CONTROL. Page 145. Case history of the use of this company's vibration control in an office building where 41 pieces of refrigeration equipment were installed in two penthouses. This vibration isolation reduces transmitted vibration and permits installation anywhere in apartment, public and industrial buildings and decreases the original building and foundation costs. Bulletin available. .....Item 283

AIR DIFFUSERS. Page 151. Round or square air diffusers which give even distribution of air throughout the conditioned area with no drafts. Diffusers are adjustable after installation which means less slide rule work before the job goes in. Data book available. .....Item 284

PUMPS. Page 167. Low cost centrifugal pumps for air conditioning service and for all types of water circulation. Catalog available. .....Item 285

INSULATION. Page 5. For summer comfort, the National Bureau of Standards rates multiple layers of aluminum first. A report of the Department of Commerce on "Effect of Ceiling Insulation upon Summer Comfort" is available at no cost from this manufacturer of aluminum insulation. .....Item 286

AIR CONDITIONING. Page 14. How packaged air conditioners save money, save space, reduce installation time and cut maintenance in a 3½ million dollar Ohio shopping center. These packaged units range from 3 to 15 tons, available for all types of applications. Information available. .....Item 287

AIR CONDITIONING. Page 53. How you profit five ways with a franchise for this line of air conditioning equipment which includes air conditioning units from 2 to 25 tons, packaged systems up to 60 tons, evaporative condensers, water chillers, and air handling units. .....Item 288

OIL PREHEATING. Page 157. A preheater to raise No. 5 and Bunker C oils and other liquids to proper flow temperature before they enter the suction pipe. Made with 14 or 16 inch diameter shell. Details available. .....Item 289

COPPER TUBE. Page 25. How copper tube pipe lines are used in a large Brooklyn brewery. These tubes can be bent to clear beams, girders and other obstructions without extra joints and fittings, and fewer fittings mean less flow resistance and lower pumping costs. Booklet available. .....Item 290

WATER CHILLERS. Pages 12-13. Centrifugal water chillers which assure stable operation down to 10% of their capacity. This is particularly important since in any air conditioning system the design load exists only part of the time. Other features include automatic unattended operation, no costly multi-level base required, hermetic design, integral load limit control, and others. Information available. .....Item 291

PRESSURE TANKS. Page 57. A pressure tank for hot water systems which has a vacuum breaker which enables you to drain a water-logged tank completely in a few minutes. Literature available. .....Item 292

PRESSURE REGULATORS. Page 172. Pressure regulators for steam, water or air regulation service for industrial, commercial or institutional applications. A catalog folder is available. .....Item 293

BOILER WATER CONTROL. Page 135. A combination pump control low water cut-off and alarm switch for boilers with operating pressures up to 150 pounds. Detailed illustration shows the numerous features and construction. No other pump control and low water cut-off offers so much field experience and time-proved dependability. .....Item 294

STEAM TRAPS. Inside front cover. A steam trap package which consists of a thermic bucket trap but which can have an internal check valve ahead of the trap as part of the package and money can be saved with the other feature, a built-in strainer trap with stainless steel screen. Steam traps booklet available. ....Item 295

COPPER TUBE. Page 21. Another big plus factor for this copper tube which comes packed in a most modern container. Individual package is ready for job or reshipping and with no half filled cartons to hamper inventory. The package stacks or hangs compactly. .....Item 296

ROOF VENTILATOR. Page 1. How this power-driven roof ventilator was used on the Ford Rotunda, which presented a unique ventilation problem. Ventilator had a 36-inch fan wheel operating at top speed and exhausting hot air from the dome at the rate of 8,000 cfm. With these ventilators, you get all the air you pay for. Ratings are not based on the capacity of the fan alone, but on the whole unit. Bulletin available. .....Item 297

HEAT TRANSFER SURFACE. Page 163. An industrial type finned tubing in a full line and available to meet all specifications. A 4¼ x 4¼ inch fin has just been added to the line. Illustrated bulletin available. .....Item 298

COOLING TOWERS. Page 137. These towers achieve maximum cooling without noise since only dry air passes through the air propulsion assembly, reducing corrosion and maintenance. Non-clogging nozzles produce maximum cooling. Compact cooling towers are of growing importance in residential cooling and bulletins are available on the company's comprehensive line. .....Item 299

AIR DRYING. Page 145. Controlled humidity air conditioning by this method which removes moisture from air by contact with a liquid in a small spray chamber. The spray contact temperature and the absorbent concentration factors easily and positively controlled, determine exactly amount of moisture remaining in leaving air. Information available. .....Item 300

AIR DIFFUSERS. Page 20. Out of sight air diffusers for acoustical block ceilings. Adapted for concealed installation in Celotex Acousti-line ceilings provide advantages heretofore possible only with metal pan. Other advantages are described. Information available. ..Item 301

AIR CONDITIONING. Page 70. Remote type of air conditioning units for multi-room installations which heat in winter and cool in summer. Chilled water or hot water are provided from a central source. The system is ideal for new construction, system is intended for hotels, motels, apartments, hospitals, offices and industrial buildings. Brochure available. .....Item 302

FRESH AIR HEATERS. Page 64. Supply heaters for heating unheated air admitted when exhaust equipment is functioning. Heaters are designed just for this use. In winter they bring in fresh air through heating coils varied to just the right temperature replacing exhausted air. In summer they circulate the air in the plant. Information available. .....Item 303

MOTORIZED DRAFT. Page 64. Draft inducers which provide positive, adequate, uniform draft regardless of variable weather conditions or inadequate chimney or breeching construction and suitable for use in connection with oil, gas, stoker-fired or hand-fired heating boilers. Bulletin available. .....Item 304

EXPANSION JOINTS. Page 2. Announcement of an expansion joint in ¾, 1, and 1¼ inch sizes, designed to meet the specific requirements of the company's forced hot water baseboard heating. The joints provide for ½ inch movement and are made with a big brass bellows. Bulletin available. .....Item 305

AIR CONDITIONING. Page 26. This air conditioning equipment was used throughout a new Domiciliary Building of the U. S. Soldier's Home. Equipment includes air conditioning unit, spray type dehumidifiers, steam coils, and pan humidifiers. Information available. .....Item 306

HOT WATER HEATING. Page 159. A single main forced hot water heating system is used in a pottery plant drying room and is overcoming many former operating difficulties when ducts were used. Rejects have been drastically reduced, operating costs lower, and process control improved. Bulletin available. .....Item 307

HINGE JOINTS. Page 139. In a high pressure steam line at the Jones & Laughlin plant in Pittsburgh, where the line was carried along bridges and trestles, conventional expansion joints at 90 degree turns would have caused excessive thrusts at the anchor points. This company's hinge joints absorb the axial movement in three directions without transmitting such pressure thrusts. .....Item 308

TEMPERATURE CONTROL. Pages 14-17. This pneumatic temperature control system was installed in a Racine school in 1903 to control mixing dampers, and today, 50 years later, is still giving even control as shown by recording thermometer charts. This system is used in a number of old and new schools in that city. .....Item 309

PACKAGED BOILERS. Page 47. Factory and on-job tests guarantee the greatest return from the boiler investment with these boilers. Only after accurate, thorough inspection and testing under operating conditions do these boilers get the final okay from the test engineers. 80% efficiency guaranteed. .....Item 310

AIR CONDITIONING UNITS. Inside back cover. Two blow-through units and a draw-through unit do double duty in the Des Moines Art Center, cooling and dehumidifying in summer, heating and humidifying in winter. The same equipment used year-round reduces initial cost and minimizes maintenance. Catalog available. .....Item 311

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Exhaust Fan

Man Cooler

Roof Ventilator

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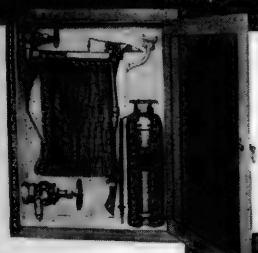

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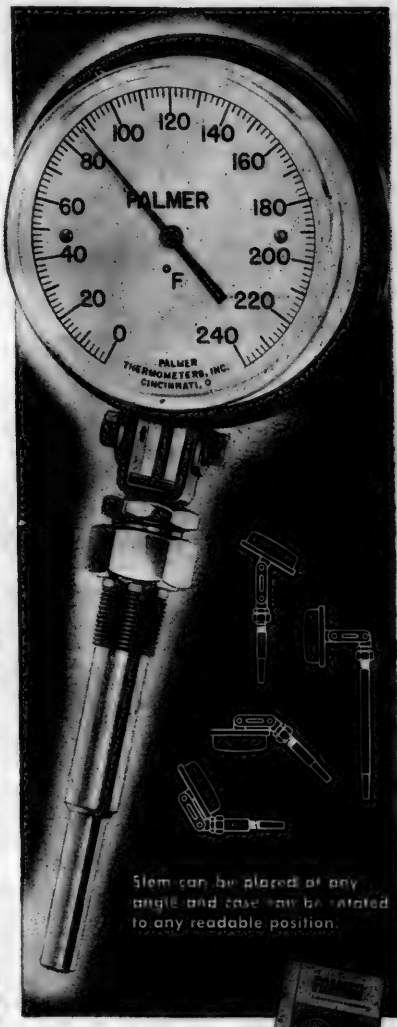

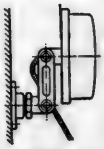

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3

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All three types have a full 4½" dial Face

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SPECIFICALLY DESIGNED FOR RESIDENTIAL APPLICATION

Unusually Quiet!

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KRAMER TRENTON CO.
Trenton 5, N.J.

(*Continued from page* 160)

coil and that on the return system on the discharge side of the combination trap. I fully realize that the orifice opening in the thermostatic element section of the trap is not equal to a ½ inch check valve opening when the check flapper is in a full open position. I have also noticed some chattering of the check under these conditions.

I have tried with reasonable success the installation of a vacuum breaker of the spring loaded type in the bypass in place of the check valve with this vacuum breaker set to open at around 10-inch vacuum. Check valves are sometimes unreliable, especially if scale or sediment lodges under the check seat. When this happens, an amount of steam could pass into the return system tending to destroy the vacuum.

F. H. Valentine
Mayer and Valentine

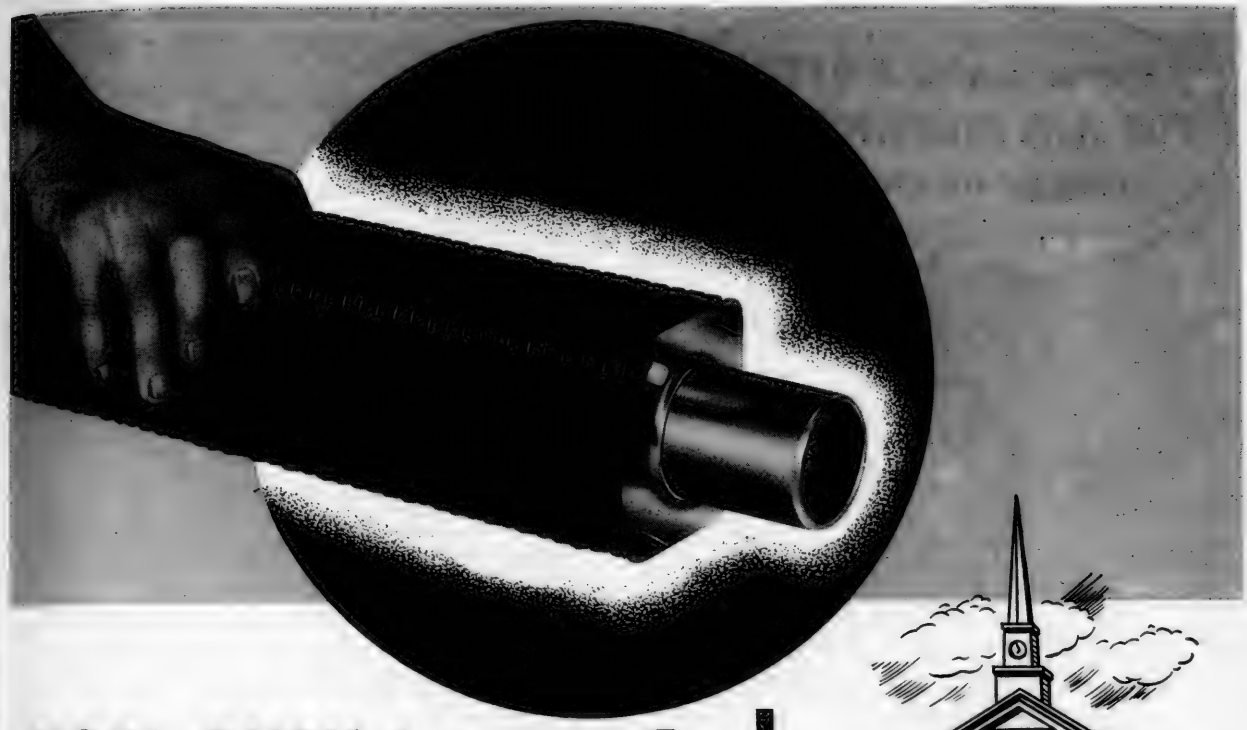
Cleveland, Ohio

Canadian Degree-Days for December, 1953*

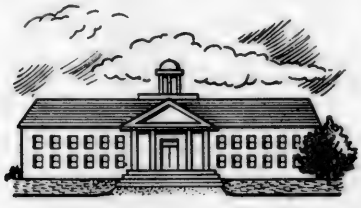
City	December		Cumulative	
	1953	Normal	1953	Normal
Calgary, Alta.	1202	1426	4089	3702
Charlottetown, P.E.I.	1045	1246	2505	2865
Crescent Valley, B. C.	1085	1240	2975	3279
Edmonton, Alta	1277	1578	3286	3984
Fort William, Ont.	1536	1596	3601	3815
Grande Prairie, Alta.	1426	1649	3722	4159
Halifax, N. S.	867	1138	2083	2615
London, Ont.	1060	1200	2393	2677
Medicine Hat, Alta.	1135	1417	2503	3389
Moncton, N. B.	1096	1373	2678	3186
Montreal, P. Q.	1119	1407	2543	3096
North Bay, Ont.	1389	1528	3181	3503
Ottawa, Ont.	1188	1494	2711	3277
Penticton, B. C.	899	1073	2345	2626
Porquis Junction, Ont.	1637	1786	3810	4248
Prince George, B. C.	1206	1504	3237	3757
Quebec City, P. Q.	1274	1534	2891	3511
Regina, Sask.	1486	1779	3445	4336
St. John, N. B.	1026	1271	2565	2969
Saskatoon, Sask.	1519	1767	3460	4249
Toronto, Ont.	963	1155	2119	2644
Vancouver, B. C.	724	818	1900	2168
Victoria, B. C.	670	738	1820	1910
Windsor, Ont.	1017	1172	2095	2446
Winnipeg, Man.	1626	1829	3470	4205

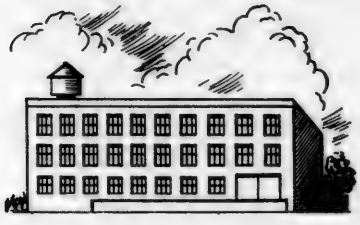
*These data are supplied through the courtesy of the Meteorological Division, Air Service Branch, Department of Transport, Canada.
The department reports slight revisions in the figures for November as published in last month's issue. Corrected figures are: Calgary, Alta., 941; Charlottetown, P. E. I., 720.

• A new division of American Radiator & Standard Sanitary Corp. has been created. Called the Amstan Supply Division, the new organization takes over all operations of the corporation's former branch house department. Headquarters of the new division are in Pittsburgh, Pa. Branches in 22 states supply materials required for plumbing, heating and air conditioning installations as well as appliances and industrial supplies. Top executives of the new division are Robert F. Sells, president and Joseph Salamone, executive vice president.



NOW...BUSH Industrial Fin to meet all specifications





Whatever your specs call for on size, output, tube, construction, etc., BUSH can now supply an industrial fin to meet them. With the recent addition of a 4¼" x 4¼" fin, BUSH now offers the heating man a line of finned surface with flexibility to meet any required output.

What's more, changes in design have been made that simplify installation . . . insure an even better job. Improved expansion hangers, for example, catch under fingers on the fin . . . provide support *from both sides.*

For all your commercial, industrial or institutional heating applications, choose BUSH Industrial Fin — now available to meet all specs.

Write today for free illustrated bulletin.

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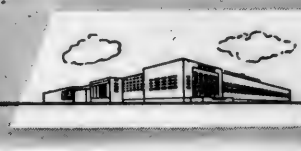

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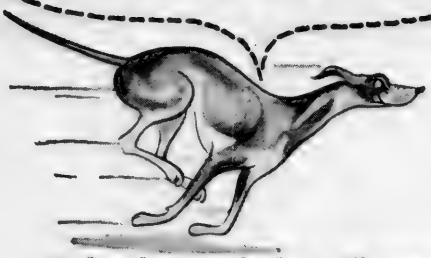

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FILTERS • AIR DIFFUSERS • EXHAUSTERS

DEGREE-DAYS FOR DECEMBER, 1953

(A) Airport readings; (C) city office readings;
(O) Readings at a point on outskirts of city.

HEATING AND VENTILATING'S 26th Year of Publication of Monthly Degree-Day Data

City	December		
	1953	1952	Normal
Abilene, Texas (A)	629	596	595
Albany, New York (A)	973	1071	1197
Albuquerque, New Mexico (A)	989	965	899
Alpena, Michigan (C)	1073	1044	1218
Anaconda, Montana (C)	(a)	1151	1238*
Asheville, North Carolina (C)	801	793	769
Atlanta, Georgia (C)	649	655	614
Atlantic City, New Jersey (C)	688	762	831
Augusta, Georgia (A)	562	593	494
Baltimore, Maryland (C)	686	747	812
Billings, Montana (A)	990	1001	1172
Binghamton, New York (C)	896	986	1113
Birmingham, Alabama (A)	662	613	596
Bismarck, North Dakota (A)	1279	1370	1535
Block Island, Rhode Island (A)	719	837	927
Boise, Idaho (A)	1039	951	1054
Boston, Massachusetts (A)	761	901	998
Bozeman, Montana (C)	(a)	1227	1293
Buffalo, New York (A)	937	975	1116*
Burlington, Iowa (A)	1041	1037	1150
Burlington, Vermont (A)	1033	1174	1308
Butte, Montana (C)	(a)	1256	1442*
Cairo Illinois (C)	791	738	784
Charleston, South Carolina (C)	375	461	410
Charlotte, North Carolina (C)	673	701	682
Chattanooga, Tennessee (A)	754	707	710
Cheyenne, Wyoming (A)	1147	1079	1125
Chicago, Illinois (C)	988	945	1074*
Cincinnati, Ohio (C)	843	793	880
Cleveland, Ohio (A)	948	929	1057
Columbia, Missouri (A)	887	927	989
Columbia, South Carolina (C)	516	574	524
Columbus, Ohio (C)	871	909	983
Concord, New Hampshire (A)	1008	1117	1271
Concordia, Kansas (C)	917	1118	1029
Dallas, Texas (A)	594	571	518
Dayton, Ohio (A)	984	935	1032
Deer Lodge, Montana (C)	(a)	1267	1331*
Denver, Colorado (C)	1033	1000	1032
Des Moines, Iowa (A)	1103	1162	1203
Detroit, Michigan (A)	964	953	1101
Devils Lake, North Dakota (C)	1513	1493	1668
Dodge City, Kansas (A)	937	1060	669
Dubuque, Iowa (C)	1212	1186	1290
Duluth, Minnesota (C)	1487	1318	1550
Eastport, Maine (A)	(a)	1082	1206
Elkins, West Virginia (A)	973	943	995
El Paso, Texas (A)	784	642	626
Ely, Nevada (A)	1262	1247	1181
Erie, Pennsylvania (C)	(a)	896	1020
Escanaba, Michigan (C)	1185	1102	1321
Evansville, Indiana (A)	895	811	871
Fargo, North Dakota	1556	1430	1615
Fort Smith, Arkansas (A)	758	745	698
Fort Wayne, Indiana (A)	1019	987	1122
Fort Worth, Texas (A)	615	563	533
Fresno, California (A)	(a)	554	580
Galveston, Texas (C)	337	288	271
Grand Junction, Colorado (A)	1166	1142	1132
Grand Rapids, Michigan (A)	1012	1037	1169
Green Bay, Wisconsin (C)	1218	1215	1392
Greensboro, North Carolina (A)	763	771	772
Greenville, South Carolina (A)	665	668	648
Harrisburg, Pennsylvania (A)	842	888	964
Hartford, Connecticut (A)	862	955	1082
Hatteras, North Carolina (C)	426	532	493
Havre, Montana (C)	1112	1288	1383
Helena, Montana (A)	1032	1305	1311
Houston, Texas (C)	396	327	303
Huron, South Dakota (A)	1393	1281	1407
Indianapolis, Indiana (A)	990	929	1051
Jackson, Mississippi (A)	583	503	503
Kansas City, Missouri (A)	890	961	970
Knoxville, Tennessee (A)	789	746	744
La Crosse, Wisconsin (A)	1201	1236	1380
Lander, Wyoming (A)	1231	1287	1383
Lansing, Michigan (A)	1031	1028	1175
Lewiston, Maine (O)	1041	1027	1295*
Lincoln, Nebraska (C)	997	1166	1113
Little Rock, Arkansas (A)	701	645	654

City	December		
	1953	1952	Normal
Livingston, Montana (C)	(a)	1019	1117*
Los Angeles, California (C)	188	281	253
Louisville, Kentucky (A)	883	791	871
Lynchburg, Virginia (A)	791	803	809
Macon, Georgia (A)	517	564	481
Madison, Wisconsin (C)	1153	1135	1287
Marquette, Michigan (C)	1190	1116	1299
Memphis, Tennessee (A)	712	647	673
Meridian, Mississippi (A)	620	540	528
Milwaukee, Wisconsin (A)	1119	1061	1218
Minneapolis, Minnesota (A)	1329	1284	1414
Moline, Illinois	1078	1062	1181
Montgomery, Alabama (A)	549	539	491
Nantucket, Massachusetts (A)	727	858	924
Nashville, Tennessee (A)	793	697	725
New Haven, Connecticut (A)	842	912	1026
New Orleans, Louisiana (C)	358	278	283
New York, New York (C)	746	821	908
Newark, New Jersey	797	860	961
Norfolk, Virginia (C)	593	621	688
North Head, Washington (C)	(a)	622	636
North Platte, Nebraska (A)	1152	1220	1172
Oakland, California (C)	427	460	508
Oklahoma City, Oklahoma (C)	769	795	747
Omaha, Nebraska (A)	1013	1180	1166
Parkersburg, West Virginia (C)	854	826	896
Peoria, Illinois (A)	1045	1005	1128
Philadelphia, Pennsylvania (C)	716	785	856
Phoenix, Arizona (C)	479	377	360
Pittsburgh, Pennsylvania (C)	827	853	924
Pocatello, Idaho (A)	1152	1176	1184
Portland, Maine (A)	982	1073	1237
Portland, Oregon (C)	610	654	701
Providence, Rhode Island (A)	817	887	1035
Pueblo, Colorado (A)	1008	1023	1051
Raleigh, North Carolina (C)	619	674	651
Rapid City, South Dakota (A)	1063	1080	1218
Reading, Pennsylvania (C)	786	847	936
Red Bluff, California (A)	473	613	564
Reno, Nevada (A)	993	952	986
Richmond, Virginia (C)	691	751	791
Rochester, New York (A)	954	974	1141
Roswell, New Mexico (A)	900	770	750
Sacramento, California (C)	487	537	567
St. Joseph, Missouri (A)	971	1055	927
St. Louis, Missouri (C)	797	832	893
Salt Lake City, Utah (A)	1086	1014	1039
San Antonio, Texas (A)	489	411	374
San Diego, California (A)	223	259	255
Sandusky, Ohio (C)	927	905	1039
San Francisco, California (C)	301	408	406
Sault Ste. Marie, Michigan (A)	1253	1157	1398
Savannah, Georgia (A)	418	500	412
Scranton, Pennsylvania (C)	880	949	1057
Seattle, Washington (C)	617	609	679
Sheridan, Wyoming (A)	1093	1103	1271
Shreveport, Louisiana (A)	588	519	490
Sioux City, Iowa (A)	1175	1285	1290
Spokane, Washington (A)	978	1069	1113
Springfield, Illinois (C)	921	912	1017
Springfield, Missouri (A)	867	889	908
Syracuse, New York (A)	926	1022	1113
Tacoma, Washington (C)	(a)	654	719
Terre Haute, Indiana (A)	996	911	1023
Toledo, Ohio (A)	983	987	1119
Topeka, Kansas (C)	902	1010	977
Trenton, New Jersey (C)	776	840	930
Tulsa, Oklahoma	736	783	750
Utica, New York (O)	1008	1087	1144*
Valentine, Nebraska (C)	1124	1243	1212
Walla Walla, Washington (C)	691	826	890
Washington, D. C. (C)	717	783	831
Wichita, Kansas (A)	876	984	915
Williston, North Dakota (C)	1280	1329	1528
Winnemucca, Nevada (C)	1079	976	1085
Yakima, Washington (A)	881	1002	1066

(a) Data not available.

*Same normal figures as previously listed by HEATING AND VENTILATING since new figures are not available. All other normal figures in this table are based on a 30-year period covering 1921 to 1950, inclusive, recently compiled and published by the U. S. Weather Bureau.

Figures in this table, with seven exceptions, based on local weather bureau reports. Exceptions are Utica and Lewiston, figures for which are furnished through the courtesy of Coke Sales Department, Central New York Power Corp., Utica, N. Y.; and Norman E. Ross, Bursar, Bates College, Lewiston, Me., respectively; Anaconda, Bozeman, Butte, Deer Lodge and Livingston, Mont., through the courtesy of the Montana Power Company.

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TESTING MATERIALS MEETING—Spring meeting of the American Society For Testing Materials, at the Shoreham Hotel, Washington, D. C. Secretary of the Society, 1916 Race St., Philadelphia 3, Pa. . . . . **MARCH 1-5, 1954.**

CORROSION ENGINEERS CONFERENCE—Tenth annual conference and exhibition of the National Association of Corrosion Engineers, in Kansas City, Mo. A. B. Campbell, Executive Secretary of the Association, 1061 M & M Building, Houston 2, Texas. . . . . **MARCH 15-19, 1954.**

INDUSTRIAL HEALTH CONFERENCE—Annual meeting of five groups, including the American Industrial Hygiene Association, at the Hotel Sherman, Chicago, Ill. Publicity Committee, 205 N. LaSalle St., Chicago 1, Ill. . . . **APRIL 26-30, 1954**

AIR POLLUTION MEETING—Annual meeting of the Air Pollution Control Association, at the Patten Hotel, Chattanooga, Tenn. Robert T. Griebling, executive secretary of the Association 4400 Fifth Ave., Pittsburgh 13, Pa. . . . **MAY 3-5, 1954**

WELDING SOCIETY MEETING—1954 National spring technical meeting of the American Welding Society, at the Hotel Statler, Buffalo, N. Y. J. G. McGrath, national secretary of the Society, 33 W. 39th St., New York 18, N. Y. . . . . **MAY 4-7, 1954.**

WELDING SOCIETY EXPOSITION—1954 Welding and Allied Industry Exposition of the American Welding Society, at the Buffalo Memorial Auditorium, Buffalo, N. Y. J. G. McGrath, national secretary of the Society, 33 W. 39th St., New York 18, N. Y. . . . . **MAY 5-8, 1954.**

INDOOR COMFORT EXPOSITION—The National Indoor Comfort Exposition, at the Commercial Museum, Philadelphia, Pa., in conjunction with the 32nd Convention of the Oil-Heat Institute of America, Inc. R. H. L. Becker, secretary of the Institute, 500 Fifth Ave., New York 36, N. Y. . . . . **MAY 16-20, 1954.**

GAS APPLIANCE MEETING—Annual meeting of the Gas Appliance Manufacturers Association, at The Drake Hotel, Chicago, Ill. H. Leigh Whitelaw, managing director of the Association, 60 E. 42nd St., New York, N. Y. . . . . **MAY 19-21, 1954.**

HEATING AND PIPING CONTRACTORS CONVENTION—65th annual convention of the Heating, Piping and Air Conditioning Contractors National Association, at the Hotel Traymore, Atlantic City, N. J. Lloyd B. Gruman, Jr., acting secretary of the Association, 1250 Avenue of the Americas, New York 20, N. Y. . . . . **MAY 24-28, 1954.**

NDHA CONVENTION—Annual convention of the National District Heating Association, at The Greenbrier, White Sulphur Springs, Va. John F. Collins, Jr., secretary of the Association, 827 N. Euclid Ave., Pittsburgh 6, Pa. . . . . **MAY 25-28, 1954.**

PLANT MAINTENANCE SHOW—Western Plant Maintenance Show at the Pan Pacific Auditorium, Los Angeles, Calif. Clapp & Poliak, Inc., 341 Madison Ave., New York 17, N. Y. . . . . **JULY, 13-15, 1954**

INTERNATIONAL INSTRUMENT CONGRESS—First International Instrument Congress and Exposition, sponsored by The Instrument Society of America, to be held in the Commercial Museum and Convention Hall, Philadelphia, Pa. Richard Rimbach, managing director of the Exposition, 921 Ridge Ave., Pittsburgh 12, Pa. . . . . **SEPTEMBER 13-25, 1954.**

POWER SHOW—21st National Exposition of Power and Mechanical Engineering, at the Comercial Museum, Philadelphia, Pa., to be held under the auspices of The American Society of Mechanical Engineers. Charles F. Roth, manager of the Exposition, 480 Lexington Ave., New York 17, N. Y. . . . . **DECEMBER 2-7, 1954.**

HEATING & VENTILATING EXPOSITION—12th International Heating & Ventilating Exposition, at the Commercial Museum and Convention Hall, Philadelphia, Pa., held under the auspices of the American Society of Heating and Ventilating Engineers. Charles F. Roth, manager of the Exposition, 480 Lexington Ave., New York 17, N. Y. . . . . **JANUARY 24-28, 1955.**

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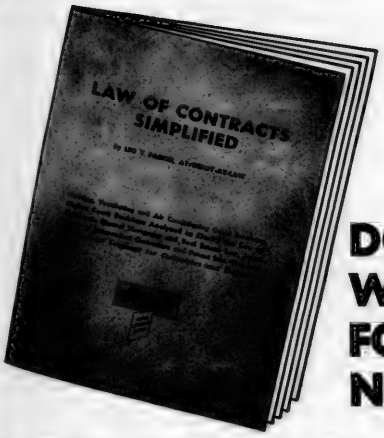

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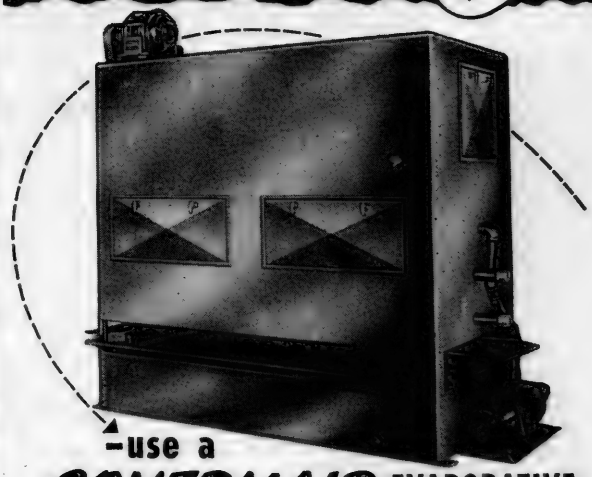

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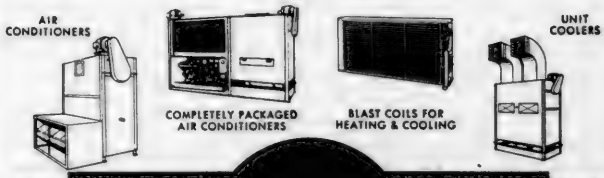

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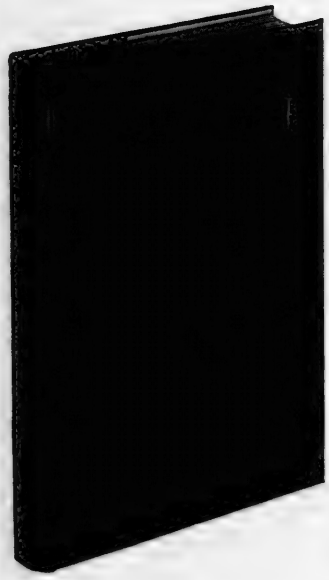

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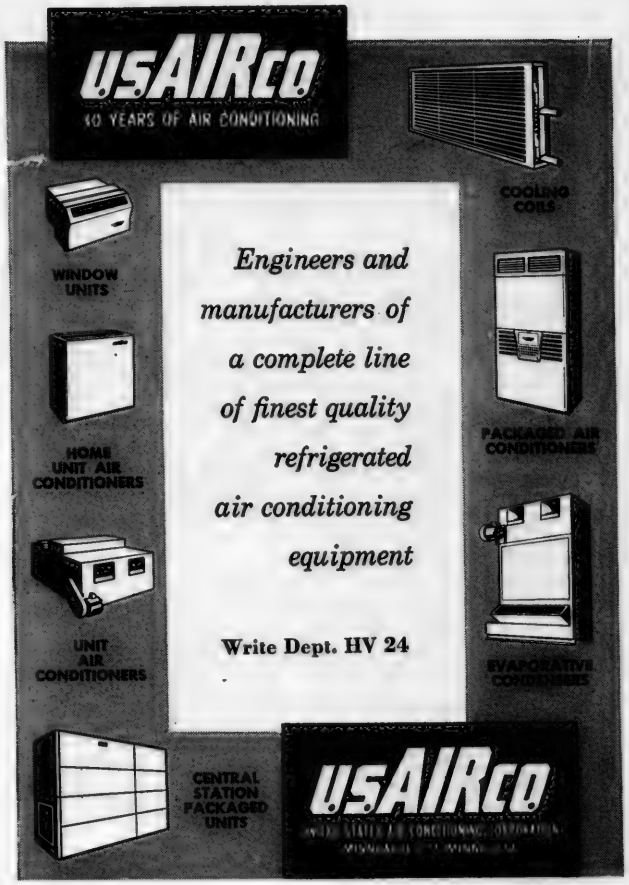

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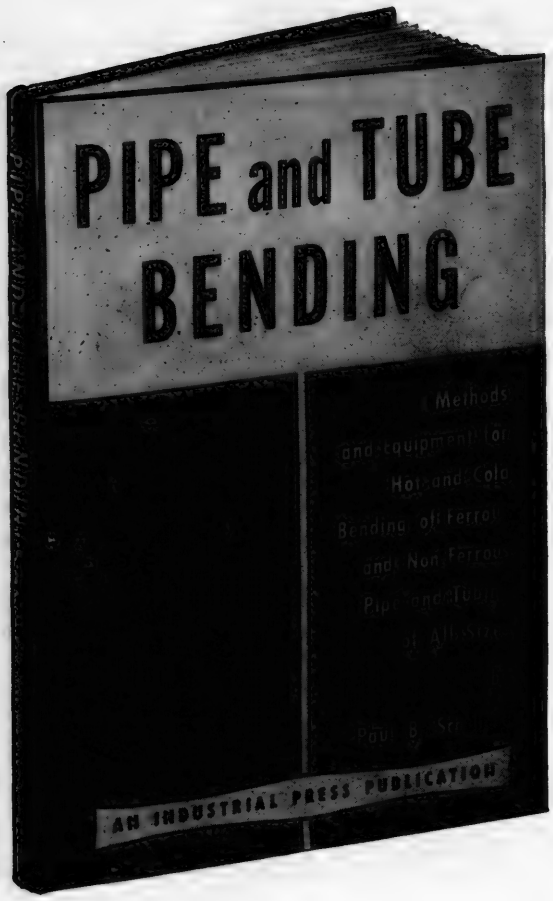

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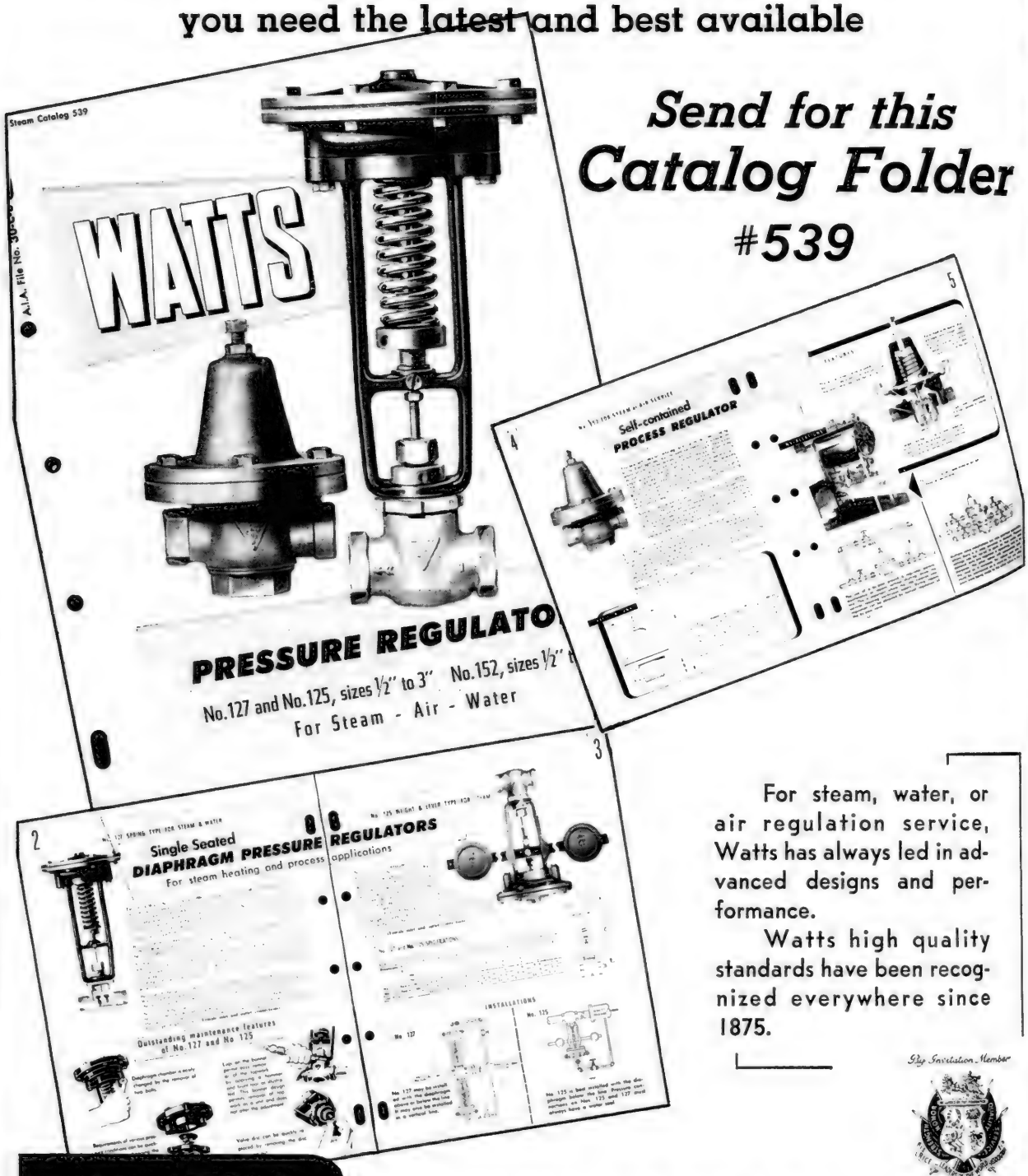

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	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
	Heat Removed per Cubic Foot of Air Being Cooled															
40	.841	.891	.940	.992	1.043	1.096	1.150	1.204	1.260	1.316	1.374	1.433	1.493	1.554	1.617	1.680
41	.807	.856	.906	.957	1.009	1.062	1.116	1.170	1.226	1.283	1.341	1.400	1.460	1.520	1.583	1.647
42	.771	.820	.870	.922	.973	1.026	1.080	1.135	1.191	1.248	1.306	1.365	1.425	1.486	1.549	1.612
43	.734	.784	.834	.886	.938	.991	1.045	1.100	1.155	1.212	1.270	1.330	1.390	1.451	1.514	1.578
44	.698	.748	.798	.849	.901	.954	1.009	1.063	1.120	1.176	1.235	1.294	1.354	1.415	1.479	1.542
45	.660	.710	.760	.812	.864	.918	.972	1.027	1.083	1.140	1.198	1.258	1.318	1.379	1.442	1.506
46	.622	.672	.722	.774	.826	.880	.934	.989	1.045	1.102	1.161	1.220	1.281	1.342	1.406	1.469
47	.583	.633	.684	.735	.788	.841	.896	.915	1.007	1.064	1.123	1.182	1.243	1.304	1.368	1.432
48	.543	.593	.644	.696	.748	.802	.857	.912	.968	1.025	1.084	1.144	1.205	1.266	1.330	1.394
49	.502	.553	.604	.656	.708	.762	.817	.872	.928	.986	1.045	1.104	1.165	1.227	1.291	1.355
50	.461	.512	.562	.615	.667	.721	.776	.831	.888	.946	1.004	1.064	1.125	1.187	1.251	1.315
51	.419	.470	.521	.573	.626	.679	.735	.790	.847	.905	.963	1.024	1.085	1.146	1.210	1.275
52	.376	.427	.478	.530	.583	.637	.692	.748	.805	.863	.922	.982	1.043	1.105	1.169	1.234
53	.333	.383	.435	.487	.540	.594	.650	.705	.762	.820	.879	.940	1.001	1.063	1.127	1.192
54	.288	.339	.390	.443	.496	.550	.605	.661	.718	.776	.836	.896	.957	1.019	1.084	1.149
55	.243	.294	.345	.398	.451	.505	.561	.617	.674	.732	.792	.852	.914	.976	1.040	1.105
56	.196	.247	.299	.352	.405	.459	.515	.571	.628	.687	.746	.807	.869	.931	.996	1.061
57	.149	.200	.252	.305	.358	.413	.469	.525	.582	.641	.700	.761	.823	.885	.950	1.015
58	.100	.151	.203	.256	.310	.365	.420	.477	.534	.593	.653	.714	.776	.838	.903	.968
59	.050	.102	.154	.207	.261	.316	.372	.428	.486	.545	.605	.666	.728	.790	.855	.921
60		.052	.104	.157	.211	.266	.322	.379	.437	.496	.556	.617	.679	.742	.807	.872
61			.052	.106	.160	.215	.271	.328	.386	.445	.505	.566	.629	.692	.757	.823
62				.054	.108	.163	.219	.276	.334	.394	.454	.515	.578	.641	.706	.772
63					.054	.110	.166	.223	.282	.341	.401	.463	.526	.589	.654	.720
64						.056	.112	.170	.228	.287	.348	.410	.473	.536	.602	.668
65							.057	.114	.173	.232	.293	.355	.418	.481	.547	.614
66								.057	.116	.176	.237	.299	.362	.426	.492	.558
67									.059	.119	.180	.242	.305	.369	.435	.502
68										.060	.121	.184	.247	.311	.377	.444
69											.061	.124	.188	.252	.318	.385
70												.063	.126	.191	.257	.324
71													.064	.128	.195	.262
72														.065	.132	.199
73															.067	.135
74																.068

HEAT REMOVED PER CUBIC FOOT OF AIR

Final Wet Bulb Temp., F.	Initial Wet Bulb Temperature, F.														
	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
	Heat Removed per Cubic Foot of Air Being Cooled														
40	1.744	1.810	1.878	1.946	2.016	2.087	2.161	2.232	2.307	2.385	2.464	2.545	2.623	2.707	2.793
41	1.711	1.777	1.845	1.914	1.984	2.055	2.128	2.199	2.275	2.353	2.432	2.513	2.591	2.676	2.762
42	1.677	1.743	1.810	1.879	1.950	2.021	2.094	2.166	2.241	2.319	2.398	2.479	2.558	2.642	2.728
43	1.642	1.709	1.776	1.845	1.915	1.987	2.060	2.132	2.208	2.286	2.365	2.446	2.525	2.609	2.695
44	1.607	1.673	1.741	1.810	1.881	1.952	2.026	2.097	2.173	2.251	2.331	2.412	2.491	2.575	2.662
45	1.571	1.638	1.705	1.775	1.845	1.916	1.990	2.062	2.138	2.216	2.296	2.377	2.456	2.541	2.627
46	1.534	1.601	1.669	1.738	1.809	1.880	1.954	2.026	2.102	2.181	2.260	2.341	2.421	2.506	2.592
47	1.497	1.564	1.632	1.701	1.772	1.843	1.917	1.990	2.066	2.144	2.224	2.305	2.385	2.470	2.556
48	1.459	1.526	1.594	1.663	1.734	1.806	1.880	1.952	2.029	2.107	2.187	2.268	2.348	2.433	2.520
49	1.420	1.487	1.555	1.625	1.696	1.768	1.842	1.914	1.991	2.069	2.149	2.231	2.310	2.396	2.482
50	1.380	1.448	1.516	1.607	1.657	1.729	1.803	1.875	1.952	2.031	2.111	2.192	2.272	2.358	2.445
51	1.340	1.407	1.476	1.546	1.617	1.689	1.763	1.836	1.913	1.992	2.072	2.153	2.234	2.319	2.406
52	1.299	1.367	1.435	1.505	1.576	1.648	1.723	1.796	1.873	1.952	2.032	2.114	2.194	2.280	2.367
53	1.258	1.325	1.394	1.464	1.535	1.607	1.682	1.755	1.832	1.911	1.991	2.073	2.154	2.236	2.327
54	1.214	1.282	1.351	1.421	1.492	1.565	1.640	1.713	1.790	1.869	1.950	1.962	2.112	2.198	2.285
55	1.171	1.239	1.308	1.378	1.450	1.522	1.597	1.671	1.748	1.827	1.908	1.990	2.071	2.157	2.244
56	1.127	1.195	1.263	1.334	1.406	1.478	1.553	1.627	1.704	1.784	1.864	1.947	2.028	2.114	2.201
57	1.081	1.149	1.218	1.289	1.361	1.434	1.509	1.583	1.660	1.740	1.820	1.903	1.984	2.070	2.158
58	1.035	1.103	1.172	1.243	1.315	1.388	1.463	1.537	1.615	1.694	1.775	1.858	1.939	2.025	2.113
59	.987	1.055	1.125	1.196	1.268	1.341	1.416	1.490	1.568	1.648	1.729	1.812	1.893	1.980	2.068
60	.939	1.007	1.076	1.149	1.220	1.293	1.369	1.443	1.521	1.601	1.682	1.765	1.847	1.933	2.022
61	.889	.958	1.027	1.099	1.171	1.244	1.320	1.395	1.473	1.553	1.634	1.717	1.799	1.886	1.974
62	.839	.908	.977	1.049	1.121	1.195	1.270	1.345	1.424	1.504	1.585	1.668	1.751	1.837	1.926
63	.787	.856	.926	.997	1.070	1.144	1.220	1.295	1.373	1.453	1.535	1.618	1.701	1.788	1.876
64	.735	.804	.874	.945	1.018	1.092	1.168	1.243	1.322	1.402	1.484	1.567	1.650	1.737	1.826
65	.681	.750	.820	.892	.965	1.039	1.115	1.190	1.269	1.350	1.432	1.515	1.598	1.685	1.774
66	.626	.695	.765	.837	.910	.984	1.061	1.136	1.215	1.296	1.378	1.462	1.545	1.632	1.721
67	.569	.639	.709	.781	.855	.929	1.005	1.081	1.160	1.241	1.323	1.407	1.491	1.578	1.667
68	.512	.581	.652	.724	.798	.872	.949	1.025	1.104	1.185	1.268	1.352	1.435	1.523	1.612
69	.453	.523	.593	.666	.739	.814	.891	.967	1.047	1.128	1.210	1.295	1.378	1.467	1.556
70	.393	.462	.533	.606	.680	.754	.831	.908	.988	1.069	1.152	1.236	1.320	1.408	1.498
71	.331	.401	.472	.545	.619	.693	.771	.848	.927	1.009	1.092	1.176	1.261	1.349	1.439
72	.267	.338	.409	.482	.556	.631	.708	.786	.866	.947	1.030	1.115	1.200	1.288	1.378
73	.203	.274	.345	.419	.493	.568	.645	.723	.803	.885	.968	1.053	1.138	1.227	1.317
74	.137	.207	.279	.352	.427	.502	.580	.658	.738	.820	.903	.988	1.073	1.162	1.253
75	.069	.140	.212	.285	.360	.435	.513	.591	.672	.754	.838	.923	1.008	1.097	1.188
76		.071	.143	.217	.292	.367	.445	.524	.604	.687	.771	.856	.942	1.031	1.122
77			.072	.146	.221	.297	.375	.454	.535	.617	.701	.787	.873	.963	1.053
78				.074	.149	.225	.304	.383	.464	.547	.631	.717	.803	.893	.984
79					.075	.152	.230	.310	.391	.474	.558	.644	.731	.821	.912
80						.077	.156	.235	.317	.400	.484	.571	.658	.748	.839

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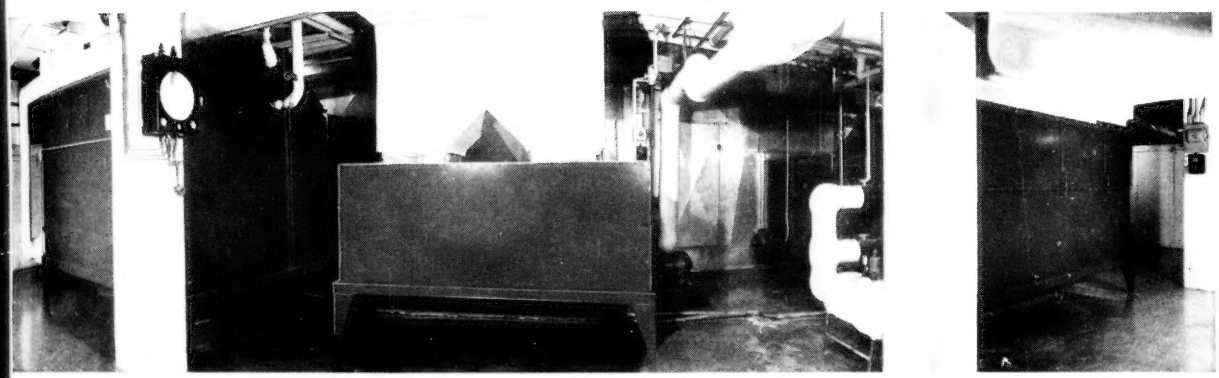

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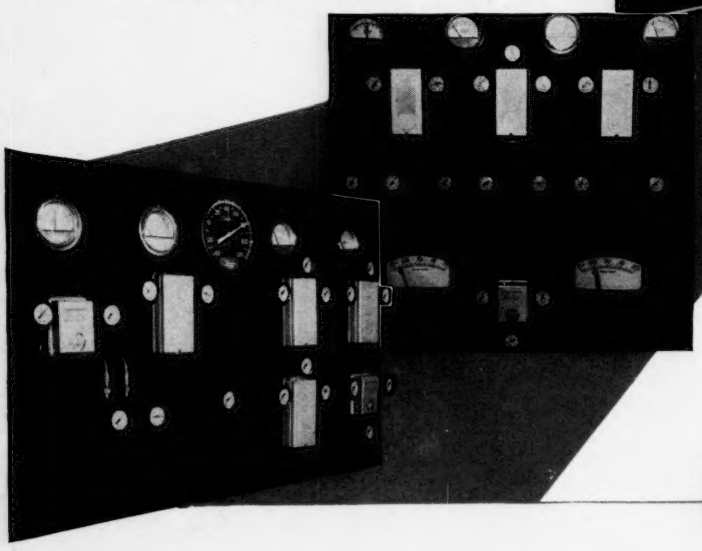

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